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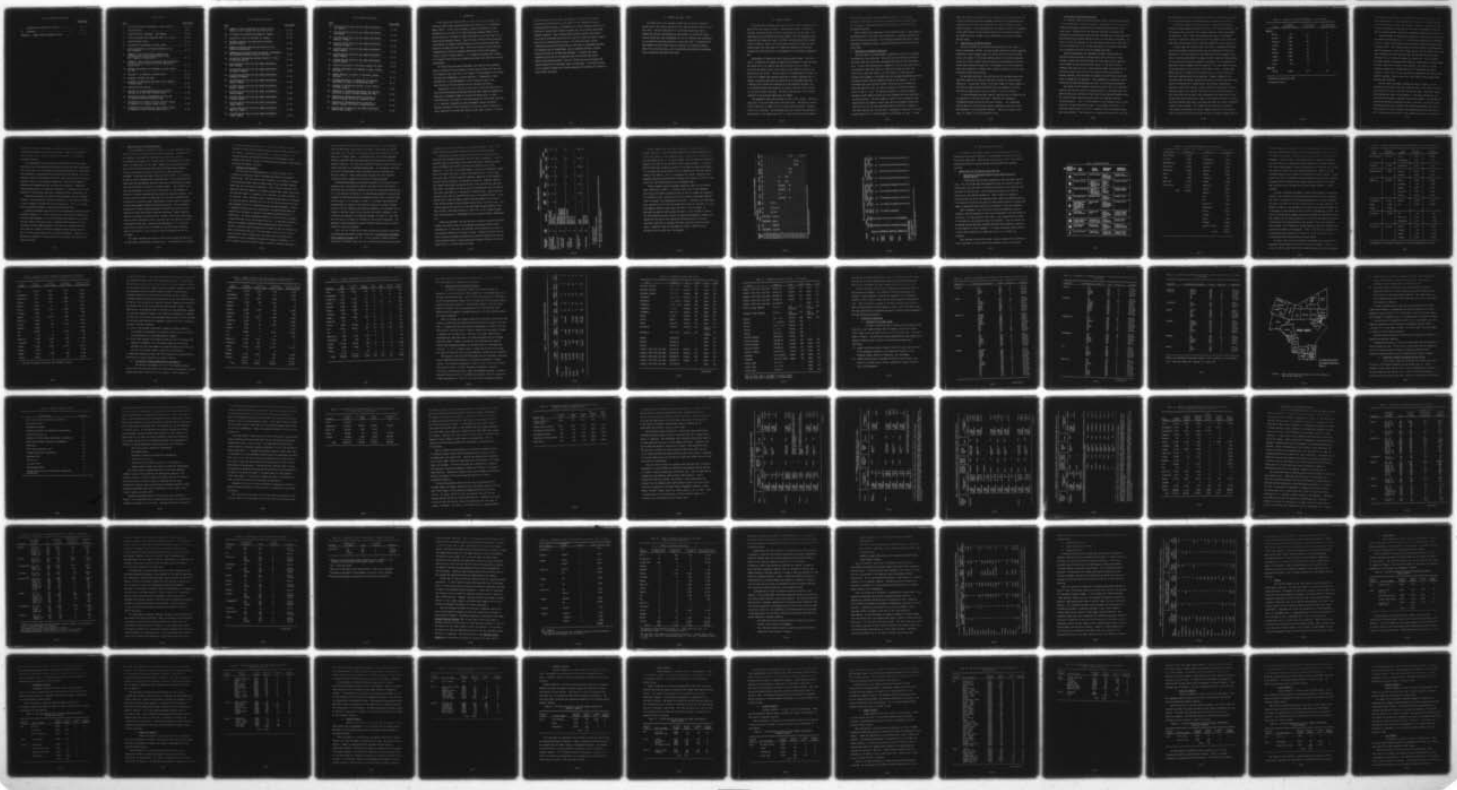

Final Report RTI/1525/00-05F

Development of Shelter Use Plans

February 1979 Work Unit 1631D

February 1979

Contract No. DCPA01-77-C-0220
DCPA Work Unit 1631D

LEVEL II

FINAL REPORT RTI/1525/00-05F

DEVELOPMENT OF SHELTER USE PLANS

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DETACHABLE SUMMARY

FINAL REPORT RTI/1525/00-05F

February 1979

Development of Shelter Use Plans

by

Milton D. Wright and Stephen B. York, III

for

Donald A. Bettge

DEFENSE CIVIL PREPAREDNESS AGENCY
Washington, D.C. 20301

under

Contract No. DCPA01-77-C-0220
Work Unit 1631D

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of the shelter plans included the construction of new expedient shelters, and it was necessary to determine the types of expedient shelters that could best utilize the available resources. The final planning step was to allocate resources to the locations where they are needed.

Two geographic areas were selected for use in this project. The first study area is the Utica-Rome area of New York State. The high-risk portion of this study area is made up of the cities of Utica and Rome, including Griffis Air Force Base. The associated host area includes the remainder of Oneida County. The second study area is in the vicinity of Macon, Georgia. The high-risk section of this study area includes the city of Macon, portions of Bibb County, and the city of Warner Robbins, including Robbins Air Force Base. The associated host area includes all or part of nine surrounding counties.

Both of these study areas have crisis relocation plans at some stage of development, and RTI used these plans extensively in developing shelter use plans for the two study areas. The final product of the study is a detailed description of the shelter use plans for each of the study areas.

III. CONCLUSIONS

Based on the experience gained during the development of shelter use plans under this effort, it is RTI's conclusion that, to be highly confident that these plans can be successfully implemented during a crisis, all of the planning work will need to be completed beforehand. The most time consuming part of the development of shelter use plans is the calculation of material and earthmoving requirements. RTI feels that is is particularly important that at least this part of the planning be completed before a crisis occurs. This implies that the data needed for making these calculations will also be obtained. These data include the allocation of people and identification of

SUMMARY

I. INTRODUCTION

Crisis Relocation Planning (CRP) is a part of the total Nuclear Civil Protection (NCP) program being developed by the Defense Civil Preparedness Agency (DCPA). In CRP, the residents of areas considered to be at high risk of receiving direct weapons effects from a nuclear attack are relocated to areas considered to be at much lower risk of receiving such weapons effects. Because most of the low-risk, or host, areas are small towns and communities, there are only a few buildings that are capable of providing the fallout protection needed in these areas. Consequently, other sources of shelter must be utilized. The options available for obtaining shelters include lightly constructed buildings and residences that can be expediently modified to improve their sheltering capability and newly constructed expedient shelters. Both of these shelter options require the use of certain resources to create the protection needed.

In this project, plans were made for identifying and distributing resources to upgrade and/or construct the shelters needed in two CRP host areas.

II. PROCEDURES USED

The development of shelter use plans in this study involved several steps. The first step was to determine the number of people to be sheltered in the host areas. The second step was to identify the shelter options to be utilized in providing the needed shelter and to determine the number of people to be sheltered by each option. The next steps in the development of shelter use plans were to compute the resources required for shelter upgrading and to conduct a survey to determine the availability of the needed resources. One

the shelter options to be used. If these planning tasks are completed beforehand, and if there is a person available within each host county to begin immediately the completion of the shelter plans in the event of a crisis, RTI is reasonably confident that the plans could be successfully implemented. This means that the survey of available materials and equipment, the allocation of materials and equipment to specific shelters, and the implementation of the shelter plans would all need to be completed within a 3-day period of time.

February 1979

DCPA Work Unit 1631D

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(11) February ~~ruary~~ 1979

(6) Development of Shelter Use Plans

by

(10) Milton D. / Wright ~~and~~ Stephen B. / York, III

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Under the concept of Crisis Relocation Planning (CRP), residents of areas considered to be likely targets of a nuclear attack are evacuated to areas of lower risk. In the relocated posture, the evacuated population will need protection from fallout radiation if a nuclear attack occurs. This report describes the procedures used to develop fallout shelter use plans for two areas that have been

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20. Abstract (Continued)

designated as host areas in crisis relocation plans. The final shelter use plan developed for each area is also described. The work consisted of the estimation of the resources required to upgrade shelters in each host area, a survey to determine the availability of the needed resources, and the development of a plan for distributing the resources to the individual shelter sites.

ABSTRACT

Under the concept of Crisis Relocation Planning (CRP), residents of areas considered to be likely targets of a nuclear attack are evacuated to areas of lower risk. In the relocated posture, the evacuated population will need protection from fallout radiation if a nuclear attack occurs. This report describes the procedures used to develop fallout shelter use plans for two areas that have been designated as host areas in crisis relocation plans. The final shelter use plan developed for each area is also described. The work consisted of the estimation of the resources required to upgrade shelters in each host area, a survey to determine the availability of the needed resources, and the development of a plan for distributing the resources to the individual shelter sites.

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I. INTRODUCTION

Crisis Relocation Planning (CRP) is a part of the total Nuclear Civil Protection (NCP) Program being developed by the Defense Civil Preparedness Agency (DCPA). In CRP, plans are made in which the residents of areas considered to be at high risk of receiving direct weapons effects from a nuclear attack are relocated to areas considered to be at much lower risk of receiving such weapons effects. High-risk areas include military bases and large centers of industry and/or population; low-risk areas include small towns and villages and rural areas. The crisis relocation option would be invoked during a period of extreme international tension which appears likely to lead to nuclear conflict. It is generally assumed that a period of at least 72 hours would be available during which the relocation could be accomplished.

If crisis relocation were implemented, the high-risk area residents would be removed from such dangers of direct weapons effects as blast and fire; however, they would still be in danger of being exposed to the fallout radiation that accompanies a nuclear explosion. Consequently, a major consideration in the development of crisis relocation plans is the identification of fallout shelters for the relocated population.

Because most of the low-risk or host areas to which the population at risk would be relocated are sparsely populated small towns and communities, there are an inadequate number of existing buildings which, in their unaltered state, are capable of providing protection from fallout radiation. It is, therefore, necessary to seek supplemental sources of shelter. Options available for providing shelter in the host areas in addition to those identified in the National Shelter Survey (NSS) include: (1) special

facilities such as mines, caves, and tunnels, (2) small and/or lightly constructed buildings which can have their fallout protection improved through expedient measures, (3) basements of private residences which can be modified to improve their protective capability, and (4) newly constructed expedient shelters. Each of these shelter options requires that certain activities be performed during the crisis period to make the shelters usable when and if an attack actually occurs. For mines and caves, minimal lighting and ventilation systems must be installed; for upgradable shelters, the upgrading must be accomplished; and for expedient shelters, shelter construction must be initiated and completed. To ensure that these upgrading activities can be completed within the 72-hour time period normally considered available, plans for identifying and distributing the required materials and equipment need to be developed. The primary purpose of this research project was to develop methods and procedures for preparing those shelter use plans.

II. PURPOSE AND SCOPE OF WORK

The objectives of this research project were to develop methods for preparing host area shelter use plans and to develop detailed plans for two host areas. The work consisted of (1) using host area survey data to compute the resource requirements for each shelter in the two host areas studied (these data were supplemented by visits to shelters when necessary), (2) surveying the available materials in each host area, (3) comparing the requirements for and availabilities of resources, (4) preparing shelter plans for the two host areas, and (5) describing the methods and procedures used in developing the shelter use plans.

III. GENERAL APPROACH

Providing fallout shelter protection is one of the many aspects of CRP. Some of the other aspects include: providing food, water, and sanitary services; providing medical services, and maintaining law and order. This study deals only with shelter use plans; however, the two geographic areas chosen for this study are a part of a DCPA pilot program and other studies covering different aspects of CRP have been conducted for these two areas. Choosing these two study areas will enable the observation of possible interactions and/or conflicts in requirements for the different elements of CRP.

Development of shelter use plans involves several steps. The first step is to determine the number of people to be sheltered in the host areas. The second step is to identify the shelter options to be utilized in providing the needed shelter and to determine the number of people to be sheltered by each option. The next steps in the development of shelter use plans are to compute the resources required for shelter upgrading and to conduct a survey to determine the availability of the needed resources. If a shelter plan includes the construction of new expedient shelters, the civil defense planner must determine the types of shelters which can best utilize the available resources. The final planning step is to allocate resources to the locations where they are needed.

Two geographic areas were selected for use in this project. The first study area is the Utica-Rome area of New York State. The high-risk portion of this study area is made up of the cities of Utica and Rome, including Griffis Air Force Base. The associated host area includes the remainder of Oneida County. The second study area is in the vicinity of Macon, Georgia.

The high-risk section of this study area includes the city of Macon, portions of Bibb County, and the city of Warner Robbins including Robbins Air Force Base. The associated host area includes all or part of nine surrounding counties.

Both of these study areas have crisis relocation plans at some stage of development and RTI used these plans extensively in developing shelter use plans for the two study areas. The following paragraphs describe in detail the general procedures pursued in developing shelter use plans for the two study areas.

A. Definition of Sheltered Population

The first step in the development of shelter use plans is to quantify the population to be sheltered. The existing crisis relocation plans for the Macon study area are further developed than those for the Utica-Rome area. In the existing Macon plans, segments of the risk-area population to be sheltered in each host county are identified, reception points are identified in each host county, and the allocation of both host-area residents and evacuees to individual shelters has been determined as well as the mode of travel from the reception points to the shelters. In the Utica-Rome area, existing plans contain instructions for residents of specified sections of the risk area to relocate to specified reception points in the host area. The host-area townships in which the people assigned to each reception point are to be sheltered are also specified in the existing plans. The total number of people to be relocated has been identified but the numbers of people who would be processed through each reception point has not been determined and the allocation of people to individual shelters has not been made. Consequently, these activities were accomplished by RTI in the development of the shelter use plan. In some

cases the number of people arriving at a reception point was not sufficient to fully utilize the available upgradable shelters in the designated host townships while in other cases there were not enough upgradable shelter spaces available. In the development of the shelter use plan, RTI suggested slight modifications to the existing allocation of risk-area residents to the reception points in order to more effectively utilize the available shelter spaces.

B. Identification of Shelter Options

Options available for providing fallout shelters in host areas, in order of preference, include: (1) existing NSS spaces which provide adequate protection in their present state; (2) special facilities such as mines, caves, and tunnels; (3) existing buildings which do not provide adequate protection in their present state but which can be expediently modified to upgrade their protective capability; (4) basements of private residences which can be modified to improve their protective capability; and (5) new, expediently constructed shelters.

As mentioned previously, the existing plan for the Macon study area identifies shelters for both the host-area residents and the relocated population. In each host county, a sufficient number of shelter spaces is available by combining existing NSS shelters and upgradable buildings. There are no usable mines, caves, or tunnels in the host counties.

In the Utica-Rome study area, specific shelters are not identified for the population in the existing plans. Therefore, RTI developed a recommended shelter posture for each host township. This recommended posture makes use of existing NSS spaces, upgradable existing buildings, home basements, and new expedient shelters. There are no usable mines, caves, or tunnels in the Utica-Rome host area.

C. Estimation of Resource Requirements

An important facet of providing fallout shelter for host-area occupants is the availability of required resources. Consequently, RTI computed the resource requirements associated with providing fallout shelters in the study areas. Calculations of the resources required to implement the upgrading of buildings were made using data from host-area survey forms that were obtained from regional offices of the U.S. Army Corps of Engineers. In order to verify the adequacy of this data source, field visits were made to all of the facilities in six of the nine counties in the Macon study area and to selected facilities in the Utica-Rome study area.

Resource requirements for upgradable shelters include earth for shielding around the exterior building walls and on the roof or floor overhead, plywood for covering windows and other exterior wall openings, 2-inch lumber for providing additional support to the roof or floor overhead, hand tools for use in installing the lumber and plywood and for placing the earth around the building, heavy earthmoving equipment to excavate and help place the earth as necessary, and skilled and unskilled labor to accomplish the upgrading. The procedures and assumptions used in estimating the required resources are given in the following paragraphs.

The volume of earth required around the exterior walls was computed by assuming that the soil would lie along the walls at a 45-degree angle and would be piled up to the level of the floor or roof above the shelter story. The volume of earth required along each wall was computed using the following formula: Soil = $1/2\ h^2L$, where h is the average height to which the earth is piled along the wall and L is the length of the wall. An additional amount equal to $1/12\ \pi h^3$ is added for the soil required around each outside corner. The volume of soil required on the floor or roof over

the shelter was computed by multiplying the floor or roof area by the depth of soil required to keep the estimated total radiation dose to 50 rads.

It should be noted at this point that it is general DCPA policy to provide a minimum protection factor (PF) of 40 in all fallout shelters. The 50 rad dose limit was used in this study to show the minimum requirements for materials. Table 1 shows the estimated 4-day dose at unprotected locations in each host county and shows the PF's needed to stay within the dose limit and the amount of soil required overhead to achieve those PF's.

In many cases, the existing floors and roofs in upgradable buildings are not sufficiently strong to support the soil required for shielding. Therefore, it will be necessary to add additional vertical members to the floor or roof over the shelter to support the soil placed on these surfaces. For the purpose of estimating resource requirements, it was assumed that additional vertical members would be required in all cases where the spans of existing floor or ceiling joists are 15 feet or more. In those cases where less than 12 inches of soil are required, it is very likely that additional supports would not be necessary. However, because of the likelihood that the shelter occupants may want to use more than the minimum amount of shielding and to guard against the low-level overpressures expected in these host counties, it was assumed that the 15-foot maximum span would apply to all shelter facilities in all of the host counties. In facilities which did not have a span indicated on the survey form, it was assumed that the existing span is equal to the shortest exterior dimension. Building dimensions were used to estimate the length over which intermediate supports would be needed. This length was then converted to material requirements by assuming that vertical members (made with 2-inch lumber) would be installed on 24-inch centers and that a horizontal member would be

TABLE 1. ESTIMATED SHIELDING REQUIREMENTS IN HOST COUNTIES

County	Estimated* 4-day Dose (rads)	PF† for 50-rad Total Dose	Soil Required Overhead (inches)
Georgia			
Monroe	700	14	8
Baldwin	1,000	20	10
Bleckley	1,500	30	12
Laurens	500	10	6
Dodge	1,200	24	10
Pulaski	1,500	30	12
Twiggs	1,600	32	12
Houston	900	18	10
Peach	700	14	8
New York			
Oneida	8,000	160	24

*Information supplied by DCPA.

†Protection Factor.

installed in the ceiling as a butt-plate for the vertical members. Using this configuration, it was estimated that 5 linear feet of 2-inch lumber would be required per linear foot along which support is needed, and that one saw, one hammer, and one pound of nails would be needed for each 100 feet or fraction thereof along which intermediate supports are to be built.

The requirement for plywood was estimated by multiplying the total area of exterior wall openings by 1.5. This factor was derived from a detailed study of a number of buildings for which exterior aperture dimensions were available to RTI. This study computed the precise amount of plywood which would be necessary to cover most windows and doors in the exterior walls and made allowances for those apertures that are left open to act as access openings or as air inlets or exhausts for ventilation. For the several buildings studied, the plywood requirement was approximately 1.5 square feet for each square foot of exterior wall opening. The factor of 1.5 was, therefore, assumed to be representative of all upgradable facilities. Although, in this study, it was assumed that plywood would be used to cover exterior openings, interior doors and 1-inch lumber could be substituted when they are available.

The only other requirement computed was that of shovels. It was estimated that one shovel would be needed for each 7 cubic yards of earth to be placed on the floor or roof over the shelter story. Additional shovels would probably be useful at the shelters if they were available but the calculations were made to represent minimum requirements. The estimate for shovels was derived by assuming that most of the soil to be placed around the exterior walls would be moved with earthmoving equipment with only a minimal amount of final placement being accomplished by hand and that the soil to be placed on the floor or roof overhead would have to be manually

loaded into buckets, wheelbarrows, or other appropriate vehicles. A single shovel was estimated to be sufficient to move at least 7 cubic yards of earth during a crisis period by rotating the operator at sufficiently frequent intervals.

The requirements for resources were calculated for each individual shelter and the values obtained were summed to obtain the total requirements for a given area. As the resource requirement calculations for each shelter were completed, an upgrading plan was prepared for each shelter. This plan contains a sketch of the shelter area which identifies the positions of any additional floor or roof supports needed and it specifies the materials needed and the upgrading actions required for the shelter. Examples of these upgrading plans are contained in Appendix A. Upgrading plans for the shelters in the two study areas were forwarded to DCPA in Washington, DC.

Resource requirements for upgrading home basements were not computed. Instead, it was assumed that sufficient materials will be locally available at each residence to accomplish the needed upgrading. This is in keeping with the guidance contained in the existing relocation plan.

Resource requirements were not explicitly computed for constructing new expedient shelters. It is RTI's opinion that a more practical approach to providing these shelters is to first determine what resources are available and then identify particular types of expedient shelters which will most efficiently utilize these resources. This opinion is based on the fact that there are a number of different expedient shelter designs, each of which utilizes varying quantities of different resources. Examples of this approach are contained in later sections of this report that describe the shelter use plans.

D. Identification of Available Resources

In the development of shelter use plans, it is very important to know both the quantities and locations of available resources. Resources which are important to successfully implementing a shelter use plan are: (1) earthmoving equipment, (2) finished lumber, (3) polyethylene, (4) hand tools, (5) green poles, and (6) labor. Because the two study areas are a part of the pilot CRP program, both areas had already been surveyed to identify and catalog both publicly and privately owned earthmoving equipment. These data were made available to RTI by DCPA. In a previous project by the Oak Ridge National Laboratory (Ref. 1), the availability of green poles was cataloged by county for the entire United States and these data were available in the form of a research report. The availability of labor was determined in a previous RTI study (Ref. 2) to be adequate to perform all required upgrading and construction of expedient shelters. As a result of the availability of these data, RTI had only to determine the availability of finished lumber, polyethylene, and hand tools to complete the data base needed to develop the shelter use plans. This was done by contacting all lumber companies located in the host area portion of the counties for which the detailed plans were developed. Lumber companies located in the high-risk areas were not included in the survey even though they are often sufficiently close to the host area that materials could be transported out and used. They were excluded because it is likely that their stock of materials will be needed for upgrading and/or expedient shelter construction in the risk area to house key workers who are not relocated.

The lumber companies were asked to report their average inventories of finished lumber, polyethylene, and hand tools. Two techniques for surveying

the lumber companies were tested. In the first, a local CD official obtained the data from the lumber companies through personal contact and in the second, a questionnaire was mailed to the lumber companies. The surveyed companies were identified through the yellow pages of local telephone directories. Results of the surveys are presented in the sections describing the shelter use plans.

E. Allocation of Resources

The final step in the development of a shelter use plan is the allocation of particular items of equipment and materials to specific shelter sites. The first part of this allocation is to identify a scheme for distributing lumber from the lumber yards to the individual shelters where they are to be used for upgrading. This is done by allocating the amounts of materials needed to the shelters nearest each lumber source until the available supply is consumed or until materials have been allocated to all shelters. Next, individual items of earthmoving equipment are allocated to upgrading specific shelters until all the available equipment-hours have been consumed or until all shelters have been assigned equipment. Finally, if expedient shelters are to be constructed, the remaining equipment and materials are allocated to specific sites where the shelters are to be constructed. The types of expedient shelters to be built should be chosen to make efficient use of the available materials. As mentioned previously, there are a number of expedient shelter designs which differ from one another in both the types and quantities of materials used for construction. Some of the designs make use of finished lumber, others use only logs or green poles cut from available trees, and some can be constructed using automobiles or doors scavenged from nearby buildings or residences. It is RTI's opinion that using finished lumber to construct expedient shelters is

much more expeditious than using logs and green poles. For that reason, when finished lumber was available in excess of that needed for shelter upgrading, the first choice of expedient shelter options were those which make use of finished lumber. In selecting sites for building expedient shelters, locations should be chosen which are suitable for building a number of shelters. This makes the delivery of materials more efficient and permits efficient use of earthmoving equipment. If the shelters are to be built with finished lumber, the sites should be easily accessible by delivery trucks; if logs or green poles are used, the sites should be located as close as possible to the source of these resources.

Earthmoving equipment can be used to excavate all of the soil used in upgrading and to place the soil against the exterior walls of existing facilities and any expedient shelters that must be constructed above ground. It is also much more efficient to use earthmoving equipment to excavate the trenches for semiburied and buried expedient shelters than to perform these tasks by hand. As in the case of lumber, it is assumed that earthmoving equipment that is located in the high-risk areas will be used to harden sites of critical industries and services; therefore, only equipment that is located in the host areas will be available for shelter upgrading. When evaluating the adequacy of earthmoving equipment available in a host area, the first step is to obtain an inventory of the available equipment. The equipment is then allocated to specific shelter upgrading tasks for which completion times are estimated.

RTI's plan for allocating available earthmoving equipment incorporates the methodology developed by Jacobs Associates in Utilization of Equipment-Crisis Relocation Program (Ref. 3). In this approach, Jacobs Associates identifies 15 different tasks that can be performed by earthmoving equipment

in upgrading buildings and constructing expedient shelters. Table 2 lists these tasks and the equipment that can be used to perform the tasks.

In developing equipment production rates by task, Jacobs Associates identifies two different sources for the soil used in upgrading. If soil is available close to the shelter site (within 250 yards), front-end loaders and/or bulldozers can be used to excavate and place the soil in one operation. If no soil is available nearby, a borrow pit (preferably located within 5 miles of the site) is used as the source of soil. One pit may serve one, two, or several groups of shelters, depending on the lengths of the haul and the volume of soil available in the pit. Backhoes, shovels, and loaders can be used to excavate the soil from the borrow pit and load the trucks. Bulldozers also may be useful to excavate and push the material into piles, particularly if the ground is frozen or hard. Dump trucks can be used to haul the soil from the borrow pits to the shelter sites. At the shelter sites, small bulldozers and/or front-end loaders can be used to place the berm material around shelters where there is operating room. Soil can be placed on the roof with a front-end loader (heights generally less than 12 feet), from boxes hoisted by a fork lift, or by a bucket brigade. Soil can be placed on an intermediate floor by bucket brigades, wheelbarrow, etc.

Earthmoving equipment can also be used to construct expedient shelters. Productivity would be low if the equipment were used at shelter sites scattered over a large area, but equipment can be effectively utilized if the expedient shelters are located in groups. Backhoes and shovels can be used to excavate trenches; bulldozers and front-end loaders can be used to place shielding material around aboveground expedient shelters in the same manner that it is placed around buildings.

TABLE 2. TASK DEFINITION

GENERAL WORK CATEGORY	TASK CODE	DEFINITION	EQUIPMENT USE (EFFICIENCY)						
			DUMP TRUCK	BACK-HOE	SHOVEL	DOZER		LOADER	
						LARGE	SMALL	LARGE	SMALL
EXCAVATE, LOAD & HAUL SHIELDING SOIL FROM BORROW AREA	A	Excavate A_S (Soft Earth) Excavate A_H (Hard Earth)	○	●	●	●	▲	▲	▲
	B	Load Trucks	○	●	●	○	○	●	▲
	C	Haul to Shelter Site	●	○	○	○	○	○	○
UPGRADING BLDGS:		Place Shielding:	○	○	○	▲	●	▲	●
1. USE SOIL FROM BORROW AREA	D	Separate Bldg.—No Basement							
	E	Separate Bldg.—W/Basement							
	F	Attached Bldg.—No Basement							
	G	Attached Bldg.—W/Basement							
2. USE SOIL EXCAVATED AT BUILDING SITE		Excavate & Place Shielding:	○	○	○	▲	▲	●	●
	H	(Same as "D")							
	I	(Same as "E")							
	J	(Same as "F")							
	K	(Same as "G")							
EXPEDIENT SHELTERS:									
1. TRENCH TYPE	L	Excavate	○	●	○	▲	▲	▲	▲
	M	Backfill	○	▲	▲	▲	●	▲	●
2. ABOVE GROUND		Place Shielding:	○	○	○	▲	▲	▲	●
	N	(Similar to "D")							
	P	(Similar to "F")							

● Equipment is suitable for task
○ Equipment is not suitable
▲ Use if more suitable equipment is not available

Source: Wickham, George E., and Henry R. Tiedemann, *Utilization of Equipment Crisis Relocation Program.* Final Report No. 145. Jacobs Associates: San Francisco, California. September 1977.

Table 3 presents the code numbers assigned by Jacobs Associates to classify equipment. This is the same classification scheme used by DCPA in the CRP Host County Critical Resources Survey (see Table 12 in Section IV) with the exception that in the Jacobs scheme, small bulldozers and front-end loaders (50 to 150 HP) are divided into four classifications. In order to determine the total production capacity of available earthmoving equipment, it is assumed that the equipment will be in operation for 60 hours during a 72-hour crisis period. This is in agreement with Jacobs' assumption that equipment operating time should be increased by 20 percent to allow for lost time or for such inefficiencies as moving between tasks.

Table 4 presents typical equipment production rates for 10 of the 15 tasks identified in Table 2. In Oneida County, most of the upgradable facilities are located in groups and most of the soil needed for upgrading is available on site. The plans are to build groups of expedient shelters close to sources of building materials and soil. Therefore, only relatively small quantities of soil must be hauled from borrow pits and there is a more than adequate number of dump trucks available. For this reason, no estimates are made for the hauling task and it is not included in Table 4. The four earthmoving tasks involved in constructing expedient shelters are essentially the same as the excavation and placing tasks in building upgrading; therefore, no separate production rates are listed for these tasks. Production rates for equipment not listed in Table 4 can be estimated from the rates that are presented.

TABLE 3. CLASSIFICATION OF EQUIPMENT – CODE NUMBERS

HORSEPOWER RATING OR CAPACITY	BULLDOZERS		FRONT-END LOADERS				MOTOR GRADERS	SHOVELS		CLAMSHELLS		BACKHOES		SCRAPERS		CRANES		TRUCKS
			End-Dump		Side-Dump													
	Crawl	Wheel	Crawl	Wheel	Crawl	Wheel	Wheel	Crawl	Wheel	Crawl	Wheel	Crawl	Wheel	Self-Propel	Self-Load	Crawl	Wheel	Wheel
50 to 75 HP	280A		160A	161A														
75 to 100 HP	280B		160B	161B														
100 to 125 HP	280C		160C	161C														
125 to 150 HP	280D		160D	161D														
Up to 150 HP					170	171	141											
150 to 200 HP	282	283	162	163	172	173	143											
200 to 250 HP	284	285	164	165	174	175	145											
250 to 300 HP	286	287	166	167	176	177												
Over 300 HP	288	289		169		179												
Up to 1 cu yd								260	261	080	081	020	021					
1 to 1½ cu yd								262		082	083							
1½ to 2 cu yd								264		084	085							
2 to 3 cu yd								266		086	087							
1 to 2 cu yd												022	023					
2 to 3 cu yd												024	025					
3 to 10 cu yd								268		088	089			251	255			311
10 to 15 cu yd														253	257			313
15 to 20 cu yd																		315
Up to 11 tons																070	071	
11 to 20 tons																072	073	
Over 20 tons																074	075	
Low Bed Truck																		317
Service Truck																		751
Tire Truck																		753
P.O.L. Truck																		755

Source: Wickham, George E., and Henry R. Tiedemann, *Utilization of Equipment Crisis Relocation Program.* Final Report No. 145. Jacobs Associates: San Francisco, California. September 1977.

TABLE 4. TYPICAL EQUIPMENT TASK PRODUCTION RATES (CU. YD./HR.)

EQUIPMENT		EXCAVATE		LOAD	PLACE SHIELDING FROM STOCKPILE				EXCAVATE AT SITE & PLACE SHIELDING			
		TASK A_S	TASK A_H	TASK 3	TASK D	TASK E	TASK F	TASK G	TASK H	TASK I	TASK J	TASK K
					Single Building		Attached Bldg.		Single Building		Attached Bldg.	
TYPE	CODE	SOFT EARTH	HARD EARTH	LOADERS ONLY	Gr Floor	Basement	Gr Floor	Basement	Gr Floor	Basement	Gr Floor	Basement
BACKHOE	020	70	55	In A_S&A_H	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
	022	140	110	" "	"	"	"	"	"	"	"	"
	024	190	150	" "	"	"	"	"	"	"	"	"
SHOVEL	260	80	60	In A_S&A_H	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
	262	160	130	" "	"	"	"	"	"	"	"	"
	264	220	180	" "	"	"	"	"	"	"	"	"
FRONT END LOADER (CRAWLER)	160A	20	10	30	25	22	19	17	18	15	13	10
	160B	35	20	55	45	40	35	30	30	28	25	18
	160C	50	30	75	55	50	45	40	40	35	30	22
	160D	65	35	100	70	65	55	50	50	42	35	28
	162	90	50	140	90	80	70	60	60	52	45	36
	164	120	70	140*	110	100	90	80	75	65	55	45
	166	160	90	140*	120	110	100	90	85	75	60	50
FRONT END LOADER (WHEELED)	161A	25	10	40	35	30	28	25	24	21	18	15
	161B	45	20	70	55	50	45	40	40	35	30	22
	161C	65	30	100	75	67	60	50	50	45	40	30
	161D	90	45	130	90	80	70	60	60	52	45	35
	163	120	60	185	120	110	95	85	85	75	60	50
	165	160	80	185*	140	125	110	100	95	85	70	58
	167	200	100	185*	160	145	125	110	105	95	80	65
DOZER (CRAWLER)	280A	60	45**	N.A.	35	35	30	30	25	25	20	20
	280B	85	65**	"	45	45	40	40	30	30	25	25
	280C	110	85**	"	50	50	45	45	35	35	30	30
	280D	140	110**	"	55	55	50	50	40	40	35	35
	282	230	180**	"	65	65	55	55	45	45	40	40
	284	330	260**	"	75	75	65	65	50	50	45	45
	286	400	320**	"	85	85	75	75	60	60	50	50
	288	520	420**	"	95	95	85	85	70	70	60	60
AVERAGE OF ALL "HOST COUNTY" UNITS					69	64	56	51	47	43	37	32
AVERAGE OF SMALL UNITS (TO 150 HP) ONLY					54	50	44	40	38	34	29	24

NOTES * Production limited by truck capacity
** Equipped with rippers

Source: Wickham, George E., and Henry R. Tiedemann, *Utilization of Equipment Crisis Relocation Program*. Final Report No. 145. Jacobs Associates: San Francisco, California. September 1977.

IV. DETAILED SHELTER USE PLANS

This section of the report presents a narrative description of the methods and calculations involved in the development of shelter use plans for the two study areas. Descriptions are also given of the final shelter posture derived and of any deficiences found and additional planning required.

A. Shelter Use Plan for Oneida County, New York

1. Definition of Sheltered Population and Identification of Shelter Options

A preliminary CRP has been developed for the Utica-Rome, New York area. This plan establishes the boundaries of the risk and host areas of Oneida County and identifies a tentative distribution of the high-risk area residents in the host area. This allocation was made on the basis of existing city and township boundaries. Table 5 shows this tentative allocation and also gives the suggested travel routes and reception centers. This tentative allocation was used with 1970 population data to estimate the number of people who would require fallout shelter in the host townships.

Table 6 presents a list of the risk cities and townships, the host townships, and the population of each area as reported in the 1970 Census of Population. For the purpose of this study, it was assumed that 80 percent of the high-risk area population would be evacuated. A part of the CRP for Utica-Rome advises host-area residents who have home basements to improvise fallout shelters in their basements. It further encourages these residents to share their basements with others who do not live in homes with basements.

Data obtained from the 1970 Census of Housing reveal that 88 percent of the private homes in Oneida County have basements and that the average

TABLE 5. EVACUATION ROUTE TABLE

ROUTE IDENTIFICATION LETTER	RISK AREA	MAIN ROUTES	RECEPTION CENTERS	RECEPTION TOWNSHIPS
A	Town of New Hartford	State Route 8 South	Sauquoit Sauquoit Valley Central School 2601 Oneida St.	Township of Paris Township of Bridgewater
B	Township of Kirkland	1) State Route 12 South - or 2) State Route 12B South To Route 315 South	Waterville Elementary School 174 E. Bacon Street	Township of Sangerfield
C	Township of Westmoreland	1) State Route 26 South - or 2) State Route 233 South to State Route 12B South	Oriskany Falls High School Cottage St.	Township of Augusta Township of Marshall
D	City of Utica (Part of)	State Route 5 West	Vernon - Vernon Downs Race Track	Township of Vernon
E	City of Rome (Part of) (Oneida County) North - State Barge Canal, East - City Limits, South - City Limits, West - City Limits	State Route 365 West	Verona Vernon-Verona-Sherrill School Rt. 234 & Beacon Light Road	Township of Verona
F	City of Rome North of Barge Canal	State Route 69 North	Camden - Central High School, Oswego & Florence Hill Streets	Township of Florence Township of Camden Township of Annsville Township of Vienna
G	Township of Whitestown Township of Marcy Township of Floyd	Route 32 North to Rt. 88 North to Rt. 58 North to 53 West	Stokes Stokes School Routes 53 & 26	Township of Western Township of Lee
H	Town of Deerfield (Part of Utica)	State Route 12 North to 35 West	Boonville Central School 110 Ford St. at Post St.	Township of Ava Township of Boonville Township of Forestport
I	City of Utica (Part of)	State Route 12 North to 35 West	Holland - Patent Middle School Rt. 365 at Elm St.	Township of Steuben Township of Remsen Township of Trenton

TABLE 6. RISK AND HOST POPULATIONS IN ONEIDA COUNTY

Risk Area	Population	Host Area	Population
New Hartford	21,430	Paris	4,579
Kirkland	9,688	Bridgewater	1,251
Westmoreland	5,093	Sangerfield	2,475
Rome (City)	50,148	Augusta	2,025
Whitestown	21,382	Marshall	2,072
Marcy	7,606	Verona	6,290
Floyd	3,620	Florence	610
Deerfield	4,104	Camden	4,942
Utica (City)	91,611	Annsville	1,917
Total	214,682	Vienna	3,979
		Western	2,072
		Lee	6,095
		Ava	541
		Boonville	3,947
		Forestport	1,173
		Vernon	4,871
		Steuben	735
		Remsen	1,366
		Trenton	4,429
		Sherrill (City)	2,986
		Total	58,355

number of persons per household is 3.2. If these figures are applied to the host-area portion of the county, it can be estimated that there are a total of 18,236 private homes in the host area and that 16,048 of these homes have basements. For this study, it was assumed that this number of basements would be sufficient to house the existing residents of the host townships. This implies some degree of sharing of basements with neighbors, but it does not assume any sharing with the relocated population. Thus, all of the relocated population was assumed to be sheltered in public shelters. At the direction of local CD planners, private residences could be used to shelter evacuees, and/or a shelter density greater than one person per 10 square feet could be used to increase the available shelter capacity in public shelters.

In order to estimate the number of people needing shelter in each host township, the allocation and population data from Tables 5 and 6 were used. The initial distribution of the relocated population to the host townships was made on the basis of the existing population of the host townships. For example, in Table 5, the residents of the town of New Hartford (21,430) are to be hosted in the townships of Paris (4,579) and Bridgewater (1,251). The initial distribution of evacuees was made by dividing the population of each host township by the combined population of the two risk townships and then multiplying by the hosted population (80 percent of the risk population). This resulted in an allocation of 13,466 evacuees to the Paris township and 3,678 to the township of Bridgewater. Table 7 lists the risk areas and the corresponding host township(s) and shows the initial allocation of the relocated population determined by the above method.

In Table 8, the initial distribution of evacuees and the existing and upgradable shelter spaces are listed for each host township. The final column of Table 8 shows the additional shelter spaces which would be needed

TABLE 7. INITIAL ALLOCATION OF RISK-AREA RESIDENTS TO THE HOST TOWNSHIPS

Risk Area	Resident Population	Host Township	Resident Population	Hosted Population*
New Hartford	21,430	Paris	4,579	13,466
		Bridgewater	1,251	3,678
Kirkland	9,688	Sangerfield	2,475	7,751
Westmoreland	5,093	Augusta	2,025	2,014
		Marshall	2,072	2,061
Rome City	50,148	Verona	6,290	14,226
		Florence	610	1,380
		Camden	4,942	11,178
		Annsville	1,917	4,336
		Vienna	3,979	8,999
Whitestown	21,382	Western	2,072	6,618
Marcy	7,606	Lee	6,095	19,468
Floyd	3,620			
Deerfield	4,104	Ava	541	314
		Boonville	3,947	2,288
		Forestport	1,173	680
Utica City	91,611	Vernon	4,871	31,312
		Steuben	735	4,724
		Remsen	1,366	8,781
		Trenton	4,429	28,472

*80 percent of the resident population from the corresponding risk area.

TABLE 8. SUMMARY OF INITIAL POPULATION ALLOCATION AND DISTRIBUTION OF FALLOUT SHELTER SPACES IN THE HOST TOWNSHIPS OF ONEIDA COUNTY

Host Township	Hosted Population	Existing Shelter Spaces	Upgradable Shelter Spaces	Expedient Shelter Spaces Required
Paris	13,466	4,323	7,034	2,109
Bridgewater	3,678	435	377	2,866
Sangerfield	7,751	2,674	1,882	3,195
Augusta	2,014	946	2,380	+ 1,312
Marshall	2,061	0	710	1,351
Verona	14,226	1,754	1,465	11,007
Florence	1,380	0	422	958
Camden	11,178	6,074	2,884	2,220
Annsville	4,336	0	146	4,190
Vienna	8,999	90	1,270	7,639
Western	6,618	0	0	6,618
Lee	19,468	0	6,113	13,355
Ava	314	0	44	270
Boonville	2,288	5,126	1,165	+ 4,003
Forestport	680	831	570	+ 721
Vernon	31,312	6,246	11,279	13,787
Steuben	4,724	0	0	4,724
Remsen	8,781	1,910	968	5,903
Trenton	28,472	0	677	27,795

+ - indicates an excess of existing plus upgradable spaces.

in each host township. This number was obtained by subtracting the existing and upgradable shelter spaces from the hosted population. The additional shelter spaces would have to be supplied by building new expedient shelters. As can be seen in Table 8, three of the host townships (Augusta, Boonville, and Forestport) have more shelter spaces available in existing and upgradable shelters than the population allocated to them. Because expedient shelters are generally considered to be the least desirable type of shelter, the allocation of evacuees to the host township was modified to make maximum use of the existing and upgradable shelter spaces. In this modification, an attempt was made to maintain the same relationship between risk and host townships; however, this proved to be unfeasible if complete utilization of all existing and upgradable shelter spaces is to be achieved. The following modifications are suggested to obtain the final allocation of evacuees to the host townships:

(1) Shift 1,312 evacuees from Marshall township to Augusta township. This reduces the requirement for expedient shelter spaces in Marsnall to 39 and uses all of the excess spaces in Augusta.

(2) Shift 4,003 evacuees from Steuben to Boonville and 721 evacuees from Steuben to Forestport. This eliminates Steuben as a host area, decreases the total requirement for expedient shelters by 4,724, and uses all of the excess spaces in Boonville and Forestport.

If these modifications are made, the final allocation of evacuees and the distribution of shelter spaces are as shown in Table 9.

2. Estimation of Resource Requirements for Upgrading

The material requirements for all of the upgradable shelter facilities in the host-area portion of Oneida County were computed using the methods described in Section III of this report. Table 10 shows the

TABLE 9. SUMMARY OF FINAL POPULATION ALLOCATION AND DISTRIBUTION OF FALLOUT SHELTER SPACES IN THE HOST TOWNSHIPS OF ONEIDA COUNTY

Host Township	Hosted Population	Existing Shelter Spaces	Upgradable Shelter Spaces	Expedient Shelter Spaces Required
Paris	13,466	4,323	7,034	2,109
Bridgewater	3,678	435	377	2,866
Sangerfield	7,751	2,674	1,882	3,195
Augusta	3,326	946	2,380	0
Marshall	749	0	710	39
Verona	14,226	1,754	1,465	11,007
Florence	1,380	0	422	958
Camden	11,178	6,074	2,884	2,220
Annsville	4,336	0	146	4,190
Vienna	8,999	90	1,270	7,639
Western	6,618	0	0	6,618
Lee	19,468	0	6,113	13,355
Ava	314	0	44	270
Boonville	6,291	5,126	1,165	0
Forestport	1,401	831	570	0
Vernon	31,312	6,246	11,279	13,787
Steuben	0	0	0	0
Remsen	8,781	1,910	968	5,903
Trenton	28,472	0	677	27,795
Total	171,746	30,409	39,386	101,951

TABLE 10. RESOURCE REQUIREMENTS FOR UPGRADING IN ONEIDA COUNTY, NEW YORK

Township	Soil (yd^3)	2" Lumber (lf)	Plywood (Sheets)	Nails (lbs)	Saws (No.)	Hammers (No.)	Shovels (No.)
Paris	13,066	16,550	304	33	35	35	758
Bridgewater	649	0	4	0	0	0	82
Sangerfield	4,130	1,600	118	3	4	4	290
Augusta	6,754	4,165	119	8	10	10	403
Marshall	2,530	2,080	28	4	5	5	153
Verona	2,855	2,800	50	6	7	7	152
Florence	808	150	11	1	1	1	67
Camden	9,064	6,450	198	13	17	17	571
Annsville	297	0	1	0	0	0	43
Vienna	6,846	14,430	20	29	30	30	790
Lee	16,917	39,100	367	79	88	88	993
Ava	147	0	3	0	0	0	15
Boonville	7,764	2,775	108	6	6	6	516
Forestport	848	250	24	1	1	1	92
Vernon	25,109	25,930	406	52	60	60	1,630
Remsen	4,999	3,350	92	7	9	9	239
Trenton	1,259	0	23	0	0	0	136
Total	104,042	119,630	1,876	512	273	273	6,930

estimated material requirements by township and the total for the county. Soil requirements for upgrading are also shown.

3. Identification of Available Resources

In order to evaluate the feasibility of accomplishing the upgrading in a crisis situation, the availability of the needed materials in the host area was determined. Local CD officials obtained this information for RTI through personal contact with all lumber and building supply dealers located in the host townships. Lumber dealers located in the risk areas were not included in this survey because of the likelihood that their materials would be needed to upgrade shelters for critical-industry workers who are not evacuated.

Table 11 presents the average inventories of materials available by the township in which they are located and gives the total available in the host area. A comparison of the total material requirements in Table 10 with the total material availabilities in Table 11 reveals that the supply of lumber is adequate, but not hand tools. There are, of course, other types of businesses that stock hand tools, but these businesses were not surveyed under this effort. However, the CRP for the Utica-Rome area contains instructions directing evacuees to carry hand tools with them when they relocate. It is RTI's judgment that, if these instructions are followed, the supply of hand tools will be quite adequate to accomplish the upgrading.

The results of the pilot CRP Host County Critical Resources Survey were used to determine the availability of earthmoving equipment in Oneida County. This survey was conducted in 1974 as a part of the pilot CRP Host Area Facility Survey. Critical resources are defined to be water facilities, sanitary facilities, food, and emergency equipment. Emergency equipment consists entirely of earthmoving equipment--with the exception of cranes and generators. Table 12 lists the types of emergency equipment

TABLE 11. AVAILABILITY OF MATERIALS IN ONEIDA COUNTY

Township	2" Lumber (lf)	4" Lumber (lf)	Plywood (Sheets)	Polythylene (ft^2)	Axes (no.)	Saws (no.)	Hammers (no.)	Shovels (no.)	Picks (no.)
Paris	100,000	0	0	0	0	0	0	0	0
Sangerfield	1,200,000	60,000	6,000	120,000	12	36	60	0	0
Boonville	185,000	1,150	1,400		25	6	19	38	6
Vernon	100,000	500	250	20,000	8	30	40	50	70
Trenton	90,000	3,000	2,300	260,000	0	15	15	0	0
Total	1,675,000	64,650	9,950	400,000	45	87	134	88	76

TABLE 12. EMERGENCY EQUIPMENT AND CODES

Item	Capacity	Type	Code*	Type	Code*
Backhoes w/dipper	1/2 - 1 CY	Crawler	020	Wheel	021
Backhoes w/dipper	1/2 - 2 CY	Crawler	022	Wheel	023
Backhoes w/dipper	2 - 3 CY	Crawler	024	Wheel	025
Clamshells	1/2 - 1 CY	Crawler	080	Wheel	081
Clamshells	1 - 1-1/2 CY	Crawler	082	Wheel	083
Clamshells	1-1/2 - 2 CY	Crawler	084	Wheel	085
Clamshells	2 - 3 CY	Crawler	086	Wheel	087
Clamsheels	over 3 CY	Crawler	088	Wheel	089
Cranes	To 10 T	Crawler	070	Wheel	071
Cranes	10-20 T	Crawler	072	Wheel	073
Cranes	over 20 T	Crawler	074	Wheel	075
Generators	To 50 KW	Portable	130	Truck Mounted	131
Generators	over 50 KW	Portable	132	Truck Mounted	133
Graders	100-150 HP	-	-	Wheel	141
Graders	150-200 HP	-	-	Wheel	143
Graders	200-250 HP	-	-	Wheel	145
Loaders, front end, end dump	100-150 HP	Crawler	160	Wheel	161
Loaders, front end, end dump	150-200 HP	Crawler	162	Wheel	163
Loaders, front end, end dump	200-250 HP	Crawler	164	Wheel	165
Loaders, front end, end dump	250-300 HP	Crawler	166	Wheel	167
Loaders, front end, end dump	over 300 HP	-	-	Wheel	169

(Continued)

TABLE 12. EMERGENCY EQUIPMENT AND CODES (Continued)

Item	Capacity	Type	Code*	Type	Code*
Loaders, front end, side dump	100-150 HP	Crawler	170	Wheel	171
Loaders, front end, side dump	150-200 HP	Crawler	172	Wheel	173
Loaders, front end, side dump	200-250 HP	Crawler	174	Wheel	175
Loaders, front end, side dump	250-300 HP	Crawler	176	Wheel	177
Loaders, front end, side dump	over 300 HP	-	-	Wheel	179
Scrapers, Road, Wheeled	to 10 CY	Self propelled	251	Self loading	255
Scrapers, Road, wheeled	10-15 CY	Self propelled	253	Self loading	257
Shovels	1/2 - 1 CY	Crawler	260	Wheel	261
Shovels	1 - 1-1/2 CY	Crawler	262	-	-
Shovels	1-1/2 - 2 CY	Crawler	264	-	-
Shovels	2 - 3 CY	Crawler	266	-	-
Shovels	over 3 CY	Crawler	268	-	-
Tractors w/dozer	100-150 HP	Crawler	280	-	-
Tractors w/dozer	150-200 HP	Crawler	282	Wheel	283
Tractors w/dozer	200-250 HP	Crawler	284	Wheel	285
Tractors w/dozer	250-300 HP	Crawler	286	Wheel	287
Tractors w/dozer	over 300 HP	Crawler	288	Wheel	289
Trenchers	to 16" width	Ladder	300	Wheel	301
Trenchers	over 16" width	Ladder	302	Wheel	303
Trucks, dump	to 10 CY	-	-	Wheel	311
Trucks, dump	10 - 15 CY	-	-	Wheel	313
Trucks, dump	15-20 CY	-	-	Wheel	315

*Add (a) after code if equipment is publicly owned.
*Add (b) after code if equipment is privately owned.

surveyed and the code signifying each type. A distinction is made between publicly and privately owned equipment because publicly owned equipment should be utilized before privately owned equipment of the same type.

The pilot CRP Host County Critical Resources Survey was conducted in Oneida County by township. An inventory of earthmoving equipment by township is useful because it enables the equipment to be allocated to shelters in the vicinity of their source, thus minimizing transportation time. Table 13 contains a summary of available earthmoving equipment in each of Oneida County's 19 host townships. Data in this table were used in the next planning step to determine equipment allocation and the adequacy of existing earthmoving equipment.

4. Allocation of Resources

a. Allocation of Finished Lumber

In order to determine how to allocate the available building materials to the locations where they are needed, the position of each lumber supply source was identified on a map of the host area. This map is shown in Figure 1. By using this map and considering the requirements for expedient shelters given in Table 9, the following procedure was formulated:

(1) Lumber from the two sources located in Boonville would be distributed to the upgradable shelters in the townships of Boonville, Ava, Florence, Camden, Annsville, Forestport, Lee, and Remsen.

(2) Lumber from the source in Sangerfield would be distributed to the shelters in Vernon, Verona, Vienna, Sangerfield, Augusta, Marshall, Paris, and Bridgewater.

TABLE 13. INVENTORY OF EARTHMOVING EQUIPMENT IN HOST TOWNSHIPS OF ONEIDA COUNTY

Location*	Earthmoving Equipment†	Code	Quantity	Ownership
Florence	FEL	161	1	Public
	FEL	161	25	Private
	Dozer	280	1	Public
	Dozer	280	1	Private
	DT	311	1	Public
Camden	FEL	160	1	Public
	FEL	161	22	Private
	Grader	141	1	Public
	Gradall	261	1	Public
	Dozer	280	1	Public
	Dozer	280	1	Private
	Shovel	260	1	Public
	DT	311	4	Public
Annsville	Grader	143	1	Public
	Grader	141	1	Public
	Dozer	282	1	Public
	Dozer	280	2	Public
	Dozer	280	1	Private
	Shovel	260	2	Public
	BH	021	1	Public
	FEL	161	2	Public
	FEL	161	25	Private
	DT	311	15	Public
Vienna	FEL	161	1	Public
	FEL	161	17	Private
	Dozer	280	1	Public
	Dozer	280	2	Private
	Grader	141	1	Public
	BH	021	1	Private
	DT	311	5	Public
Vernon	Gradall	021	1	Public
	Dozer	280	2	Public
	Dozer	280	7	Private
	Dozer	282	1	Private
	FEL	161	2	Public
	FEL	161	43	Private
	FEL	160	3	Private
	Grader	141	1	Public
	Grader	141	3	Private
	BH	021	1	Public
	BH	021	2	Private
	BH	020	3	Private
	DT	311	5	Public
	DT	311	4	Private
	DT	313	7	Private

(Continued)

TABLE 13. INVENTORY OF EARTHMOVING EQUIPMENT IN HOST TOWNSHIPS OF ONEIDA COUNTY (Continued)

Location*	Earthmoving Equipment†	Code	Quantity	Ownership
Augusta	FEL	161	1	Public
	FEL	161	37	Private
	Grader	141	1	Public
	Dozer	280	2	Private
	DT	311	6	Public
Marshall	FEL	161	1	Public
	FEL	161	38	Private
	Gradall	021	1	Public
	Grader	141	1	Public
	Dozer	280	1	Public
	Dozer	280	1	Private
	Dozer	281	1	Private
	DT	311	4	Public
	DT	311	3	Private
Sangerfield	FEL	161	1	Public
	FEL	161	36	Private
	Grader	141	1	Public
	BH	021	1	Public
	BH	021	1	Private
	Dozer	280	2	Private
	DT	311	15	Public
	DT	311	3	Private
Bridgewater	FEL	161	1	Public
	FEL	161	30	Private
	Dozer	280	1	Public
	Dozer	280	1	Private
	Grader	141	1	Public
	DT	311	3	Public
Ava	BH	021	1	Public
	FEL	161	1	Public
	FEL	161	12	Private
	Dozer	280	1	Public
	Dozer	280	1	Private
	DT	311	4	Public
Boonville	FEL	160	1	Public
	FEL	161	4	Private
	Grader	141	2	Public
	BH	021	2	Public
	BH	021	1	Private
	BH	020	1	Private
	Dozer	280	1	Public
	Dozer	280	3	Private
	Dozer	282	1	Private

(Continued)

TABLE 13. INVENTORY OF EARTHMOVING EQUIPMENT IN HOST TOWNSHIPS OF ONEIDA COUNTY (Continued)

Location*	Earthmoving Equipment†	Code	Quantity	Ownership
Boonville (Con't)	Shovel	260	1	Public
	Shovel	260	1	Private
	Shovel	266	1	Private
	DT	311	10	Public
	DT	311	1	Private
	DT	313	10	Private
Forestport	FEL	161	1	Public
	Grader	141	1	Public
	DT	311	3	Public
Remsen	Grader	141	1	Public
	FEL	161	1	Public
	FEL	161	15	Private
	Dozer	280	1	Private
	DT	311	2	Public
Trenton	Shovel	260	1	Public
	Trencher	301	1	Public
	Gradall	260	1	Public
	FEL	171	1	Public
	FEL	161	1	Private
	Grader	141	1	Public
	DT	311	11	Public
Steuben	FEL	161	1	Public
	FEL	161	10	Private
	Gradall	021	1	Public
	Grader	141	1	Public
	DT	311	2	Public
Verona	FEL	161	1	Private
	Dozer	280	1	Private
	DT	311	7	Public

*There is no earthmoving equipment located in Paris, Western, or Lee Townships.

†FEL - Front end loader; BH - Backhoe; DT - Dump truck

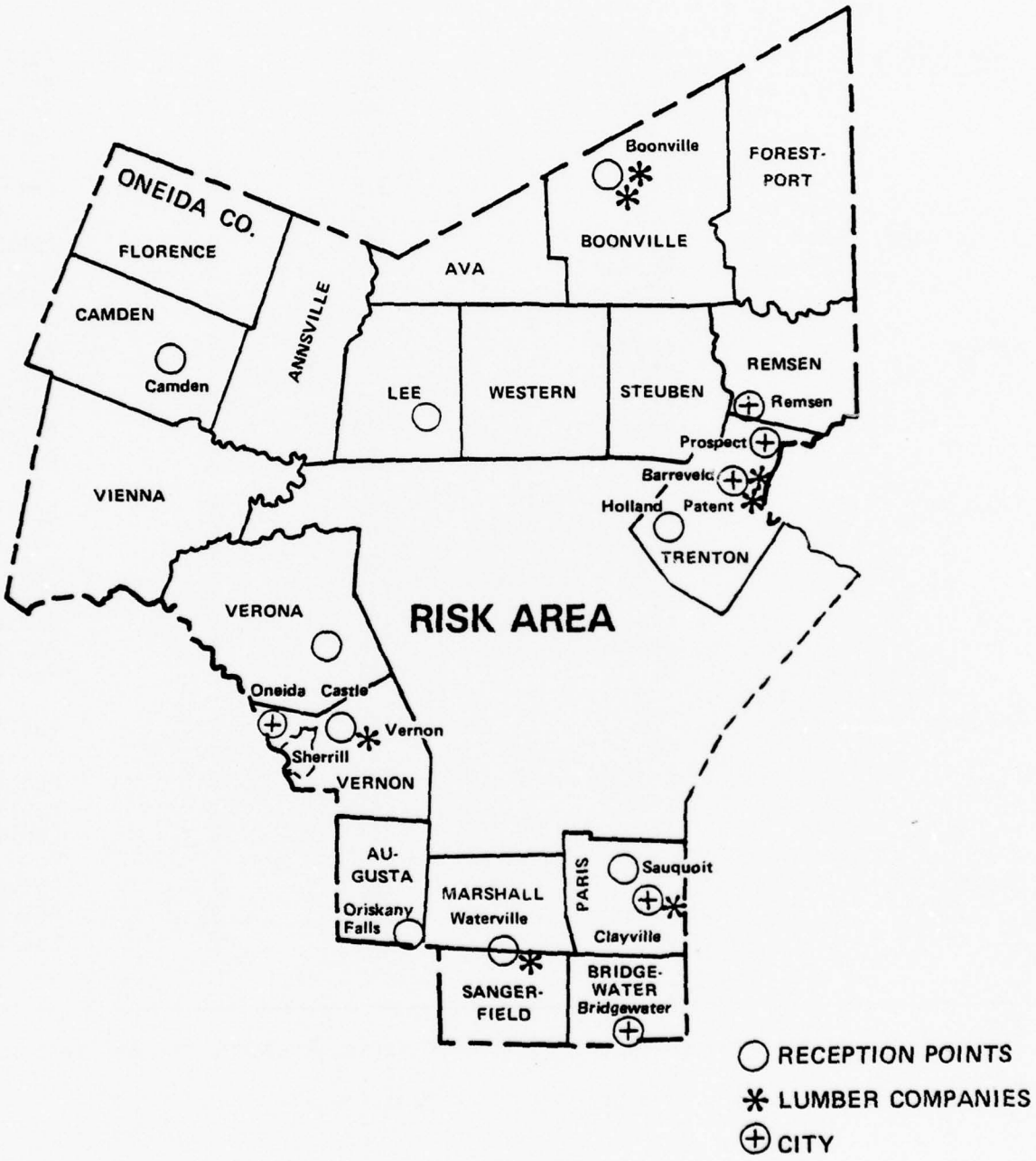

Figure 1. Map of Oneida County Showing the Host Area Townships and the Risk Area Part

(3) Lumber from the two sources in Barnveld (Trenton Township) would go only to the shelters in Trenton, leaving most of these supplies available for the construction of expedient shelters.

(4) The lumber source in Vernon does not stock sufficient plywood to upgrade the shelters in Vernon township, consequently these supplies will be kept for building expedient shelters. The lumber supply in Paris township stocks only 2-inch lumber and this, too, will be used to build expedient shelters.

If these distributions are used, 52,075 linear feet (lf) of 2-inch lumber and 804 sheets of plywood would be taken from Boonville for use in upgrading, leaving 132,925 lf of 2-inch lumber, 1,150 lf of 4-inch lumber, and 596 sheets of plywood for use in the construction of expedient shelters.

From the source in Sangerfield, 67,555 lf of 2-inch lumber, and 1,049 sheets of plywood would be distributed to upgradable shelters leaving 1,132,445 lf of 2-inch lumber, 60,000 lf of 4-inch lumber, and 4,951 sheets of plywood to build expedient shelters.

The entire stock available in Vernon and Paris would be available for constructing expedient shelters.

As described previously, a total of 171,746 people must be sheltered in the Utica-Rome host area. Of this total, 30,409 people can be accomodated in existing shelter spaces and 39,386 in upgradable shelter spaces; therefore, expedient shelters must be constructed for 101,951 evacuees.

b. Selection of Specific Expedient Shelter Options

In a previous study, RTI estimated the resource requirements for each of 15 different expedient shelter designs (Ref. 2). These expedient shelter types are the initial list of candidates for inclusion in the Utica-Rome host area shelter plan. Table 14 lists these expedient shelter options with their capacities. Several of the shelters are designed

TABLE 14. EXPEDIENT SHELTER OPTIONS

Shelter Type	Capacity
Small pole (buried, semiburied, aboveground)	12
Log-covered trench	4
Catenary wire roofed	5
Two-family A-frame pole (semiburied, aboveground)	10
Shored-trench stoop-in	4
Two-family A-frame lumber (semiburied, aboveground)	10
Rigid frame (buried, semiburied, aboveground)	60
Trench wall	60
Rigid frame, continuous vent	60
A-frame (semiburied, aboveground)	60
Wood-grate roof	60
Trailer van	56
Car-over-trench	5
Door-covered-trench	4
Lumber version of small pole (buried, semiburied, aboveground)	12

to be built either buried, semiburied, or aboveground, others can be built either semiburied or aboveground. The buried or semiburied option should be used first, depending on the depth of the water table. Only if the water table is very shallow should the aboveground option be constructed. Current DCPA policy considers only one- and two-family shelters (maximum capacity of 12) as viable host area alternatives. This reduces the list of candidates in Table 14 by six. Of the remaining nine options; catenary wire roofed, car-over-trench, and door covered-trench shelters are last resorts to be constructed only if there are severe shortages of construction materials. This further reduces the list of expedient shelters to be considered for inclusion in the Utica-Rome host area shelter plan to the following:

- small pole (buried, semiburied, aboveground),
- log-covered trench,
- two-family A-frame pole (semiburied, aboveground),
- shored-trench stoop-in,
- two-family A-frame lumber (semiburied, aboveground), and
- lumber version of small pole (buried, semiburied, aboveground).

The limiting factor in determining which of the above expedient shelters to use is the availability of construction resources. The resources which are in short supply and for which there are no suitable substitutes should dictate the choice of expedient shelter types. Construction resources used in the building of expedient shelters include earthmoving equipment, hand tools, polyethylene, 2-inch lumber, 4-inch lumber, plywood, and green poles.

Earthmoving equipment greatly facilitates the excavation tasks; however, since these tasks can be accomplished by hand, the availability of earthmoving equipment is not critical. Although hand tools are essential,

it is assumed that the evacuees will bring tools from home, therefore, the supply of hand tools should not be limited. There is an apparent shortage of polyethylene, however, only building suppliers were surveyed by RTI. Rolls of polyethylene should also be available from lawn and garden stores, hardware stores, and many department stores. Also, shower curtains, shower curtain liners, plastic trash bags, etc. can serve as adequate substitutes for rolls of polyethylene. Hence, this apparent shortage is not felt to be constraining.

Four-inch lumber is required only for the construction of shored-trench stoop-in shelters and can be substituted for by joining two 2-inch boards; therefore the supply is not critical. Oak Ridge identified sufficient timber resources to construct expedient shelters for all of the residents of Oneida County (Ref. 1). Although the abundant supply of timber might seem to imply that all of the expedient shelters should be constructed from green poles, this is not felt to be the most satisfactory plan for two reasons. One reason is that many more people have experience working with finished lumber than with green poles. A second and more important factor is that the logistics of actually procuring and delivering the building materials to the shelter site would be simpler if finished lumber is used instead of timber (the timber, in a multitude of shapes and sizes, is scattered over acres of land with varied and various types of ownerships).

Therefore, the list of critical construction resources to consider in determining which expedient structure to build is reduced to 2-inch lumber and plywood.

Table 15 displays the quantities of 2-inch lumber and plywood, as well as 4-inch lumber and polyethylene, that are available for the construction

TABLE 15. AVAILABILITY OF BUILDING MATERIALS FOR EXPEDIENT SHELTERS IN THE HOST AREA OF ONEIDA COUNTY

Township	2" Lumber (bf)	4" Lumber (bf)	Plywood (sf)	Polyethylene (sf)
Paris	100,000	0	0	0
Sangerfield	1,132,445	80,000	158,432	120,000
Boonville	132,925	1,533	19,072	0
Vernon	100,000	667	8,000	20,000
Trenton	90,000	4,000	72,864	260,000
Total	1,555,370	86,200	258,368	400,000

of expedient shelters in the Utica-Rome host area. The quantities of 2-inch and 4-inch lumber available are listed in board feet because these boards are needed in more than one dimension. Table 15 was derived from Table 11 by subtracting the building material requirements for upgrading existing buildings from the total supply. In converting the quantities of lumber from linear feet to board feet, it was assumed that the average dimensions of 2-inch lumber are 2 inches by 6 inches and of 4-inch lumber are 4 inches by 4 inches. Therefore, one linear foot of 2-inch lumber is one board foot, whereas 9 linear inches of 4-inch lumber is one board foot. This is important to realize when joining two 2-inch boards as a substitute for 4-inch lumber.

Table 16 presents the requirements for construction resources of the six expedient shelter options under consideration for inclusion in the Utica-Rome host area shelter plan. Three of the shelters are constructed from finished lumber instead of green poles until the supplies of finished lumber are expended. To minimize the need for transportation, townships with sources of construction materials should have priority in the use of these materials. Construction materials that are not needed to satisfy the shelter requirements of the source township should be utilized in neighboring townships.

Of the three expedient shelter options that are constructed from finished lumber, the lumber version of small pole shelter uses as little or less 2-inch lumber, 4-inch lumber and polyethylene than the other two options. The lumber version of small pole shelter also requires less plywood than the two-family A-frame lumber shelter. Therefore, the lumber version of small pole shelter should be constructed until the supply of plywood is expended. Of course, if the lumber supply is exhausted before

TABLE 16. CONSTRUCTION MATERIAL REQUIREMENTS PER SPACE FOR THE CANDIDATE EXPEDIENT SHELTER OPTIONS

Shelter Type	2" Lumber (bf)	4" Lumber (bf)	Plywood (sf)	Poly-ethylene (sf)	Green Poles (bf)
Lumber version of small pole	50.8	0.0	42.7	26.0	0.0
Shored-trench stoop-in	100.0	39.3	0.0	50.0	0.0
Two-family A-frame pole	1.9	0.0	0.0	60.0	138.0
Log-covered trench	0.0	0.0	0.0	56.3	134.0
Two-family A-frame lumber	77.8	0.0	54.4	120.0	0.0
Small pole	3.9	0.0	0.0	100.0	196.0

the plywood, green pole shelters must be constructed. If a supply of lumber remains when all of the plywood has been used, shored-trench stoop-in shelters (which require no plywood) can be constructed. Two-inch lumber can be joined and substituted for 4-inch lumber, thus, even if the supply of 4-inch lumber is expended, shored-trench stoop-in shelters can be constructed until there is no more 2-inch lumber.

Three different types of green pole shelters have been identified as candidate expedient shelter options to construct when the finished lumber supply is exhausted. The log-covered trench requires the smallest quantity of green poles and also has no 2-inch lumber requirement. Therefore, this option should be chosen if the earth will stand in self-supporting walls. The two-family A-frame pole shelter requires fewer green poles and less 2-inch lumber and should be chosen before the small pole shelter. Depending on the water table depth, the two-family A-frame pole shelter can be buried, semi-buried, or aboveground.

Tables 17 and 18 display the procedure that was described in preceding paragraphs as it was followed in determining the expedient shelter options to include in the Utica-Rome host area shelter plan. Table 17 describes the procedure for the townships with finished lumber supplies. (Paris, Sangerfield, Boonville, Vernon, and Trenton). Table 18 describes the procedure for the townships that need expedient shelters but within which there are no suppliers of finished lumber (Bridgewater, Marshall, Verona, Remsen, Florence, Camden, Annsville, Vienna, Western, Lee, and Ava). Table 19 summarizes the final distribution of fallout shelter spaces to be included in the Utica-Rome host area shelter plan.

TABLE 17. DETERMINATION OF EXPEDIENT SHELTER OPTIONS TO EMPLOY IN TOWNSHIPS WITH FINISHED LUMBER SUPPLIES

Township	Building Materials Available		Expedient Shelter Spaces Required	Expedient Shelter Type	Spaces	Building Materials Required	
	Material	Quantity*				Material	Quantity
Paris	2" lumber	100,000 bf	2,109	Shored-trench stoop-in	559	2" lumber	99,837 bf
	4" lumber	0				4" lumber	0
	Plywood	0				plywood	0
	Polyethylene	0				polyethylene	27,950 sf
	2" lumber	1,636 f	1,550	Log-covered trench	1,550	2" lumber	0
	4" lumber	0				4" lumber	0
	Plywood	0				Plywood	0
	Polyethylene	(27,950 sf)				Polyethylene	87,265 sf
	2" lumber	163 bf	0				
	4" lumber	0					
	Plywood	0					
	Polyethylene	(115,215 sf)					
Sangerfield	2" lumber	1,132,445 bf	3,195	Lumber version of small pole	3,195	2" lumber	162,306 bf
	4" lumber	80,000 bf				4" lumber	0
	Plywood	158,432 sf				Plywood	136,427 sf
	Polyethylene	120,000 sf				Polyethylene	83,070 sf
	2" lumber	970,139 bf	0	The remaining building materials should be used in neighboring townships, i.e., Bridgewater, Marshall, Verona, Vienna, etc., until the supply is expended.			
	4" lumber	80,000 bf					
	Plywood	22,005 sf					
	Polyethylene	36,930 sf					
Boonville	2" lumber	132,925 bf	0	Boonville's building materials should be used in neighboring townships, i.e., Remsen, Ava, Western, etc., until the supply is expended.			
	4" lumber	1,533 bf					
	Plywood	19,072 sf					
	Polyethylene	0					
Vernon	2" lumber	100,000 bf	13,787	Lumber version of small pole	187	2" lumber	9,500 bf
	4" lumber	667 bf				4" lumber	0
	Plywood	8,000 sf				Plywood	7,985 sf
	Polyethylene	20,000 sf				Polyethylene	4,862 sf
	2" lumber	90,500 bf	13,600	Shored-trench stoop-in	575†	2" lumber	90,424 bf
	4" lumber	667 bf				4" lumber	667 bf
	Plywood	15 sf				Plywood	0
	Polyethylene	15,138 sf				Polyethylene	28,750 sf

(Continued)

TABLE 17. DETERMINATION OF EXPEDIENT SHELTER OPTIONS TO EMPLOY IN TOWNSHIPS WITH FINISHED LUMBER SUPPLIES (Continued)

Township	Building Materials Available		Expedient Shelter Spaces Required	Expedient Shelter Type	Spaces	Building Materials Required	
	Material	Quantity				Material	Quantity
Vernon (Continued)	2" lumber	76 bf	13,025	Log-covered trench	13,025	2" lumber	0
	4" lumber	0				4" lumber	0
	Plywood	0				Plywood	0
	Polyethylene	(13,612 sf)				Polyethylene	733,308 sf
	2" lumber	76 bf	0				
	4" lumber	0					
	Plywood	0					
	Polyethylene	(746,920 sf)					
Trenton	2" lumber	90,000 bf	27,795	Lumber version of small pole	1,706	2" lumber	86,665 bf
	4" lmber	4,000 bf				4" lumber	0
	Plywood	72,864 sf				Plywood	72,846 sf
	Polyethylene	260,000 sf				Polyethylene	44,356 sf
	2" lumber	3,335 bf	26,089	Shored-trench stoop-in	33	2" lumber	3,300 bf
	4" lumber	4,000 bf				4" lumber	1,297 bf
	Plywood	18 sf				Plywood	0
	Polyethylene	215,644 sf				Polyethylene	1,650 sf
	2" lumber	35 bf	26,056	log-covered trench	26,056	2" lumber	0
	4" lumber	2,703 bf				4" lumber	0
	Plywood	18 sf				Plywood	0
	Polyethylene	214,194 sf				Polyethylene	1,466,953 sf
	2" lumber	356 bf	0	The extra 4" lumber could be used in Sangerfield, but the small amount probably is not worth the transportation involved.			
	4" lumber	2,703 bf					
	Plywood	18 sf					
	Polyethylene	(1,252,759 sf)					

*( ) indicate a shortage. Shower curtains, trash bags, etc. can be used to substitute for sheets of polyethylene.

†16 shored-trench stoop-in shelters can be constructed using 4" lumber as specified. 2" lumber joined to create 4" lumber should be substituted in construction of the remaining 559 shelters. Note that with the dimensions assumed herein, 1 bf of 2" lumber is 1' long, but 1 bf of 4" lumber is only 9" long, therefore, combining 2 bf of 2" lumber yields a 1' length of 4" lumber or 1.33 x the length of 1 bf of 4" lumber.

TABLE 18. DETERMINATION OF EXPEDIENT SHELTER OPTIONS TO EMPLOY IN TOWNSHIPS WITHOUT FINISHED LUMBER SUPPLIES

Township with Building Material Supply	Building Materials Available		Township Utilizing Building Materials	Expedient Shelter Spaces Required	Expedient Shelter Type	Spaces	Building Materials Required	
	Material	Quantity*					Material	Quantity
Sangerfield	2" lumber 4" lumber Plywood Polyethylene	970,139 bf 80,000 bf 22,005 sf 36,930 sf	Bridgewater	2,866	Lumber version of small pole	515	2" lumber 4" lumber Plywood Polyethylene	26,162 bf 0 21,991 sf 13,390 sf
	2" lumber 4" lumber Plywood Polyethylene	943,976 bf 80,000 bf 14 sf 23,540 sf	Bridgewater	2,351	Shored-trench stoop-in	2,351†	2" lumber 4" lumber Plywood Polyethylene	222,064 bf 80,000 bf 0 117,550 sf
	2" lumber 4" lumber Plywood Polyethylene	721,912 bf 0 14 sf (94,010 sf)	Bridgewater	0				
	2" lumber 4" lumber Plywood Polyethylene	721,912 bf 0 14 sf (94,010 sf)	Marshall	39	Shored-trench stoop-in	39	2" lumber 4" lumber Plywood Polyethylene	6,197 bf 0 0 1,950 sf
	2" lumber 4" lumber Plywood Polyethylene	715,715 bf 0 14 sf (95,960 sf)	Verona	11,007	Shored-trench stoop-in	4,504	2" lumber 4" lumber Plywood Polyethylene	715,686 bf 0 bf 0 225,200 sf
	2" lumber 4" lumber Plywood Polyethylene	19 bf 0 0 (321,160 sf)	Verona	6,503	Log-covered trench	6,503	2" lumber 4" lumber Plywood Polyethylene	0 0 0 366,119 sf
	2" lumber 4" lumber Plywood Polyethylene	19 bf 0 0 (687,279 sf)	Verona	0				
Boonville	2" lumber 4" lumber Plywood Polyethylene	132,925 bf 1,533 bf 19,072 sf 0	Remsen	5,903	Lumber version of small pole	446	2" lumber 4" lumber Plywood Polyethylene	22,657 bf 0 19,044 sf 11,596 sf
	2" lumber 4" lumber Plywood Polyethylene	110,268 bf 1,533 bf 28 sf (11,596 sf)	Remsen	5,457	Shored-trench stoop-in	708**	2" lumber 4" lumber Plywood Polyethylene	110,204 bf 1,533 bf 0 35,350 sf

(Continued)

TABLE 18. DETERMINATION OF EXPEDIENT SHELTER OPTIONS TO EMPLOY IN TOWNSHIPS WITHOUT FINISHED LUMBER SUPPLIES (Continued)

Township with Building Material Supply	Building Materials Available		Township Utilizing Building Materials	Expedient Shelter Spaces Required	Expedient Shelter Type	Spaces	Building Materials Required	
	Material	Quantity					Material	Quantity
Boonville (Continued)	2" lumber	64 bf	Remsen	4,749	Log-covered trench	4,749	2" lumber	0
	4" lumber	0					4" lumber	0
	Plywood	28 sf					Plywood	0
	Polyethylene	(46,946 sf)					Polyethylene	237,450 sf
	2" lumber	646 bf	Remsen	0				
	4" lumber	0						
	Plywood	28 sf						
	Polyethylene	(284,396 sf)						
No more finished lumber materials are available in the Utica-Rome host area. Remaining shelter requirements are satisfied by building log-covered trench shelters. Substitutions must be made for polyethylene requirements.								
			Florence	958	Log-covered trench	958	Polyethylene	53,935 sf
			Camden	2,220	Log-covered trench	2,220	Polyethylene	124,986 sf
			Annsville	4,190	Log-covered trench	4,190	Polyethylene	235,897 sf
			Vienna	7,639	Log-covered trench	7,639	Polyethylene	430,076 sf
			Western	6,618	Log-covered trench	6,618	Polyethylene	372,593 sf
			Lee	13,355	Log-covered trench	13,355	Polyethylene	751,887 sf
			Ava	270	Log-covered trench	270	Polyethylene	15,201 sf

*( ) indicate a shortage. Shower curtains, trash bags, etc. can be used to substitute for sheets of polyethylene.

†2,035 shored-trench stoop-in shelters can be constructed using 4" lumber as specified. Two-inch lumber joined to create 4" lumber should be substituted in the construction of the remaining 316 shelters. Note that with the dimensions assumed herein, 1 bf of 2" lumber is 1' long, but 1 bf of 4" lumber is only 9" long, therefore combining 2 bf of 2" lumber yields a 1' length of 4" lumber or 1.33 x the length of 1 bf of 4" lumber.

**39 shored-trench stoop-in shelters can be constructed using 4" lumber as specified. Two-inch lumber joined to create 4" lumber should be substituted in construction of the remaining 669 shelters. Note that with the dimensions assumed herein, 1 bf of 2" lumber is 1' long, but 1 bf of 4" lumber is only 9" long, therefore combining 2 bf of 2" lumber yields a 1' length of 4" lumber or 1.33 x the length of 1 bf of 4" lumber.

TABLE 19. SUMMARY OF FINAL DISTRIBUTION OF FALLOUT SHELTER SPACES IN THE UTICA-ROME HOST AREA SHELTER PLAN

Host Township	Hosted Population	Existing Shelter Spaces	Upgradable Shelter Spaces	Lumber Version of Small Pole	Shored-Trench Stoop-in	Log-Covered Trench
Paris	13,466	4,323	7,034	0	559	1,550
Bridgewater	3,678	435	377	515	2,351	0
Sangerfield	7,751	2,674	1,882	3,195	0	0
Augusta	3,326	946	2,380	0	0	0
Marshall	749	0	710	0	39	0
Verona	14,226	1,754	1,465	0	4,504	6,503
Florence	1,380	0	422	0	0	958
Camden	11,178	6,074	2,884	0	0	2,220
Annsville	4,336	0	146	0	0	4,190
Vienna	8,999	90	1,270	0	0	7,639
Western	6,618	0	0	0	0	6,618
Lee	19,468	0	6,113	0	0	13,355
Ava	314	0	44	0	0	270
Boonville	6,291	5,126	1,165	0	0	0
Forestport	1,401	831	570	0	0	0
Vernon	31,312	6,246	11,279	187	575	13,025
Steuben	0	0	0	0	0	0
Remsen	8,781	1,910	968	446	708	4,749
Trenton	28,472	0	677	1,706	33	26,056
Total	171,746	30,409	39,386	6,049	8,769	87,133

c. Allocation of Earthmoving Equipment

In using the Jacobs Associates' methodology (described under "General Approach") to allocate earthmoving equipment in Oneida County, equipment was first assigned to upgradable buildings. It was assumed that equipment would be used in the township in which it is located, with the exception of Lee and Paris Townships. No earthmoving equipment is located in these townships, hence, equipment from neighboring townships (Lee from Annsville and Paris from Bridgewater) was assigned to be used in these townships. In each township, the upgradable buildings were classified as one of four types: single building with no basement, single building with basement, attached building with no basement, and attached building with basement. Based on photographs of the buildings, it was determined that single buildings could be upgraded using soil excavated on site and that attached buildings would require soil from a borrow pit. The amount of soil needed for berm and for shielding overhead was calculated by summing the individual building requirements within each classification of buildings. These quantities of soil were then used to estimate the number of machine-hours required for excavating, loading, and placing the soil.

Two factors were used in determining the type of equipment to assign to each upgrading task. These were the efficiency of the equipment for a particular building upgrading task and the efficiency of the equipment for expedient shelter construction (both determined from Table 2). An effort was made to use appropriate equipment in upgrading the buildings while saving equipment that is particularly well suited for expedient shelter construction (i.e., backhoes, shovels, gradalls, and trenchers). Bulldozers and graders can be used for excavation at the borrow pits. Front-end loaders can be used for loading soil into dump trucks at the borrow pits, and for all excavation and placement of soil at the shelter site. Table 20

TABLE 20. UTILIZATION OF EARTHMOVING EQUIPMENT BY TOWNSHIP

Township*	Equipment† Available (Number)	Code	Equipment Hours Available	Equipment Hours Required By Existing Facilities**	Equipment Hours Remaining
Vienna	FEL (18)	161	1,080	96.5	983.5
	Dozer (3)	280	180	0	180
	Grader (1)	141	60	0	60
	BH (1)	021	60	0	60
Ava	FEL (13)	161	780	2.3	777.7
	Dozer (2)	280	120	0	120
	BH (1)	021	60	0	60
Boonville	FEL (1)	160	60	60	0
	FEL (4)	161	240	57.2	182.8
	Dozer (4)	280	240	21.4	218.6
	Dozer (1)	282	60	0	60
	Grader (2)	141	120	41.1	78.9
	BH (3)	021	180	0	180
	BH (1)	020	60	0	60
	Shovel (2)	260	120	0	120
	Shovel (1)	266	60	0	60
Forestport	FEL (1)	161	60	12.2	47.8
	Grader (1)	141	60	0	60
Vernon	FEL (45)	161	2,700	410.6	2,289.4
	FEL (3)	160	180	0	180
	Dozer (9)	280	540	0	540
	Dozer (1)	282	60	0	60
	Gradall (1)	021	60	0	60
	Grader (4)	141	240	24.6	215.4
	BH (3)	020	180	0	180
	BH (3)	021	180	0	180
Remsen	FEL (16)	161	960	83.3	876.7
	Dozer (1)	280	60	0	60
	Grader (1)	141	60	0	60
Trenton	FEL (1)	171	60	18.1	41.9
	FEL (1)	161	60	0	60
	Shovel (1)	260	60	0	60
	Trencher (1)	301	60	0	60
	Gradall (1)	260	60	0	60
	Grader (1)	141	60	0	60
Verona	FEL (1)	161	60	43.1	16.9
	Dozer (1)	280	60	12.9	47.1

(Continued)

TABLE 20. UTILIZATION OF EARTHMOVING EQUIPMENT BY TOWNSHIP (Continued)

Township*	Equipment† Available (Number)	Code	Equipment Hours Available	Equipment Hours Required By Existing Facilities**	Equipment Hours Remaining
Marshall	FEL (39)	161	2,340	40.5	2,299.5
	Dozer (2)	280	120	0	120
	Dozer (1)	281	60	0	60
	Gradall (1)	021	60	0	60
	Grader (1)	141	60	0	60
Augusta	FEL (38)	161	2,280	109.4	2,170.6
	Grader (1)	141	60	16.1	43.9
	Dozer (2)	280	120	0	120
Bridgewater††	FEL (31)	161	1,860	116.6	1,743.4
	Dozer (2)	280	120	0	120
	Grader (1)	141	60	5.8	54.2
Florence	FEL (26)	161	1,560	12.6	1,547.4
	Dozer (2)	280	120	0	120
Annsville***	FEL (27)	161	1,620	276.1	1,343.9
	Dozer (3)	280	180	0	180
	Dozer (1)	282	60	0	60
	Grader (1)	141	60	0	60
	Grader (1)	143	60	0	60
	Shovel (2)	260	120	0	120
	BH (1)	021	60	0	60
Camden	FEL (1)	160	60	60	0
	FEL (22)	161	1,320	96.6	1,223.4
	Shovel (1)	260	60	0	60
	Grader (1)	141	60	2.3	57.7
	Gradall (1)	261	60	0	60
	Dozer (2)	280	120	0	120
Sangerfield	FEL (37)	161	2,220	65.5	2,154.5
	BH (2)	021	120	0	120
	Grader (1)	141	60	5.5	54.5
	Dozer (2)	280	120	0	120
Steuben	FEL (11)	161	660	0	660
	Gradall (1)	021	60	0	60
	Grader (1)	141	60	0	60

*There is no earthmoving equipment located in Paris, Western, or Lee Townships.
†FEL - Front-end loader; BH - backhoe.
**Estimates derived from rates contained in Table 4.
††Earthmoving equipment from Bridgewater also used in Paris Township.
***Earthmoving equipment from Annsville also used in Lee Township.

presents a summary of the resulting allocation of equipment-hours by township. Table 21 lists the units of equipment (one unit is 60 machine-hours of one unit of equipment) that were allocated by township. In making the actual assignment of particular units of earthmoving equipment to specific townships, whole units were allocated, even if only a few hours were needed. Therefore, the units listed in Table 21 represent more equipment-hours than are shown in Table 20. Additionally, in performing the equipment allocations, publically owned equipment was utilized before privately owned equipment of the same type.

An examination of Table 20 shows that only a small percentage of the available earthmoving equipment in any township will be used for upgrading. The percentage of available equipment-hours required ranges from less than 1 percent in Ava to 15.8 percent in Boonville (46.7 percent in Vernon, but most of the data in the Critical Resources Survey were unreadable). Therefore, no shortages of equipment should be encountered due to unexpected factors such as inordinate amounts of travel or down time. Furthermore, there are sufficient quantities of equipment to permit the types of equipment that are best suited for the excavation of trenches for expedient shelters to be used exclusively for that purpose. Table 22 contains a listing of the suitable earthmoving equipment available for expedient shelter excavation.

All three types of expedient shelters included in the Utica-Rome host area shelter plan should be buried. Hence, the trenches must be excavated soon enough to allow time for shelter construction, backfilling, and covering within the 72-hour crisis period. It was assumed that shelter construction, backfilling, and covering could be completed within 24 hours, leaving 48 hours for trench excavation. Since the shelters were located in groups (thus minimizing transportation time) 40 hours were allotted for

TABLE 21. ALLOCATION OF UNITS OF EQUIPMENT BY TOWNSHIP

Township*	Earthmoving† Equipment	Code	Units** Allocated	Ownership
Vienna	FEL	161	1	Public
	FEL	161	1	Private
Ava	FEL	161	1	Public
Boonville	FEL	160	1	Public
	FEL	161	2	Private
	Grader	141	1	Public
Forestport	FEL	161	1	Public
Vernon	FEL	161	2	Public
	FEL	161	6	Private
	Grader	141	1	Public
Remsen	FEL	161	1	Public
	FEL	161	1	Private
Trenton	FEL	171	1	Public
Verona	FEL	161	1	Private
	Dozer	280	1	Private
Marshall	FEL	161	1	Public
Augusta	FEL	161	1	Public
	FEL	161	2	Private
	Grader	141	1	Public
Bridgewater††	FEL	161	1	Public
	FEL	161	3	Private
	Grader	141	1	Public
Florence	FEL	161	1	Public
Annsville***	FEL	161	2	Public
	FEL	161	4	Private
Camden	FEL	160	1	Public
	FEL	161	3	Private
	Grader	141	1	Public

(Continued)

TABLE 21. ALLOCATION OF UNITS OF EQUIPMENT BY TOWNSHIP (Continued)

Township*	Earthmoving† Equipment	Code	Units** Allocated	Ownership
Sangerfield	FEL	161	1	Public
	FEL	161	2	Private
	Grader	141	1	Public

*There is no earthmoving equipment located in Paris, Western, or Lee Townships and no equipment from Steuben Twonship is used.

†FEL - Front-end loader

**One unit is defined to be 60 machine hours of one unit of equipment.

††Earthmoving equipment from Bridgewater also used in Paris Township.

***Earthmoving equipment from Annsville also used in Lee Township.

actual equipment operation. This is in accordance with the Jacobs' (Ref. 3) assumption that equipment operating time should be increased by 20 percent to allow for lost time or other inefficiencies (such as moving between tasks). Earthmoving equipment cannot be used efficiently to backfill either the shored-trench stoop-in or the lumber version of small pole shelters. The backfill must be added in 6- to 12-inch layers and hand tamped. Assuming that all shelters are constructed in the buried mode, sufficent amounts of soil should be available from the trench excavation to satisfy the backfill and covering requirements of each of the three expedient shelter designs. Therefore, hand covering should not be difficult and it was assumed that backfilling would be accomplished in this manner.

Jacobs (Ref. 3) does not specify production rates for expedient shelter excavation. In lieu of specific rates, the excavation rates listed under Task A in Table 4 were used to allocate the earthmoving equipment contained in Table 22 for expedient shelter excavation. Jacobs (Ref. 3) determined that shovels are not suitable for expedient shelter excavation because of their limited mobility. However, since the shelters are located in groups, mobility is not a major concern, and shovels were judged by RTI to be as suitable as backhoes and gradalls for trench excavation.

Table 23 displays the number of each type of expedient shelter that must be constructed by township and the total excavation requirement in cubic yards by township. The shelter capacities illustrated in Oak Ridge's Expedient Shelter Handbook (Ref. 4) were used to derive the number of shelters required from the number of spaces required displayed in Table 19. The capacity of the lumber version of small pole shelter is 12 occupants: the capacity of both the shored-trench stoop-in and the log-covered trench shelters is 4 occupants. The specifications in the Expedient Shelter Handbook were also used to calculate the volume of soil that would be

TABLE 22. EQUIPMENT AVAILABLE FOR EXCAVATION OF EXPEDIENT SHELTER TRENCHES

Host Township	Equipment Type*	Number	Total Capacity (yd^3)†
Sangerfield	BH	2	4,600
Marshall	Gradall	1	2,300
Camden	Shovel	1	2,800
	Gradall	1	2,800
Annsville	Shovel	2	5.600
	BH	1	2,300
Vienna	BH	1	2,300
Ava	BH	1	2,300
Boonville	BH	4	9,200
	Shovel	3	8,400
Vernon	Gradall	1	2,300
	BH	6	13,800
Steuben	Gradall	1	2,300
Trenton	Gradall	1	2,300
	Trencher	1	2,300
	Shovel	1	2,800
			68,900

*BH - backhoe.
†Calculated by multiplying 40 hrs. available excavation time by production rate per unit of equipment given in Table 4.

TABLE 23. NUMBER OF EXPEDIENT SHELTERS AND ASSOCIATED TOTAL EXCAVATION REQUIREMENT

Host Township	Number of Expedient Shelters*			Total Excavation Requirements (yd^3)†
	Lumber Version of Small Pole	Shored-trench Stoop-in	Log-Covered Trench	
Paris	0	140	388	6,738
Bridgewater	43	588	0	16,922
Sangerfield	266	0	0	12,289
Augusta	0	0	0	0
Marshall	0	10	0	254
Verona	0	1,126	1,626	41,934
Florence	0	0	240	1,968
Camden	0	0	555	4,551
Annsville	0	0	1,048	8,594
Vienna	0	0	1,910	15,662
Western	0	0	1,655	13,571
Lee	0	0	3,339	27,380
Ava	0	0	68	558
Boonville	0	0	0	0
Forestport	0	0	0	0
Vernon	16	144	3,256	31,096
Steuben	0	0	0	0
Remsen	37	177	1,187	15,939
Trenton	142	8	6,514	60,178
Total	504	2,193	21,786	257,634

*The capacity of each expedient shelter is: lumber version of pole - 12, shored-trench stoop-in - 4, log-covered trench - 4.

†The excavation requirement of each expedient shelter is: buried lumber version of small pole - 46.2 yd^3, shored-trench stoop-in - 25.4 $yd.^3$, log-covered trench - 8.2 yd^3.

excavated in preparing the trench for each shelter design: the volume of soil would be 46.2 cubic yards for the buried lumber version of small pole, 25.4 cubic yards for the shored-trench stoop-in, and 8.2 cubic yards for the log-covered trench.

A comparison of the total capacity of earthmoving equipment available (displayed in Table 22) with the total excavation requirement (presented in Table 23) revealed that the available equipment provided approximately 27 percent of the capacity needed to excavate all of the trenches. Furthermore, some of the earthmoving equipment was located in townships which required no expedient shelters, and, in the cases of Marshall and Camden Townships, there was capacity in excess of what was required for that township's expedient shelters. Hence, a scheme was needed that would (1) redistribute the available earthmoving equipment to townships in which it could be used, and (2) assign the equipment to certain expedient shelters, thus leaving the remaining shelters to be excavated by hand.

In determining the types of expedient shelters to employ in each township, it was assumed that construction materials would be used first to the fullest extent required in the source township. The remaining materials would be used in adjacent townships until the supplies were exhausted, thus minimizing transportation requirements while utilizing all of the available construction materials. By proceeding to distribute earthmoving equipment in the same manner, the following allocations of equipment were made from source townships to adjacent townships:

- The 2,046 cubic yards of excess excavation capacity available in Marshall was allocated to Bridgewater.
- The 1,049 cubic yards of excess excavation capacity available in Camden was redistributed to Florence.

- Western received 13,571 cubic yards of excavation capacity from Boonville.
- Boonville's remaining 4,029 cubic yards of excavation capacity as well as Ava's 1,742 cubic yards of excess excavation capacity were allocated to Lee.
- Steuben's unused 2,300 cubic yards of excavation capacity were redistributed to Remsen.

Table 24 presents a comparison of expedient shelter excavation requirements and earthmoving equipment capacity available after the above redistribution. It can be seen that some equipment is available in all but two (Paris and Verona) of the townships requiring expedient shelter construction. All of the earthmoving equipment is used either in its source township or in an adjacent township. Adequate amounts of equipment are available to complete all of the expedient shelter excavation in Marshall, Camden, Western, and Ava Townships.

After the allocation of equipment to townships was accomplished, it was necessary to determine which types of expedient shelters would be mechanically excavated and which would be excavated by hand in townships with insufficient earthmoving equipment to mechanically excavate all of the shelters. A determination was made to use a priority scheme in which equipment would be assigned on the basis of per space excavation requirements. Of the three types of expedient shelters in the Utica-Rome host area shelter plan, the shored-trench stoop-in shelter requires the most excavation: 6.4 cubic yards per shelter space. The lumber version of small pole shelter requires 3.9 cubic yards of excavation per shelter space; the log-covered trench requires only 2.1 cubic yards per space. Therefore, assigning equipment first to the type of shelter requiring the most

TABLE 24. COMPARISON OF EXPEDIENT SHELTER EXCAVATION REQUIREMENTS AND EARTHMOVING EQUIPMENT CAPACITY AVAILABLE

Host Township	Number of Expedient Shelters*			Total Excavation Requirements† (yd^3)	Township Supplying Equipment	Total Excavation Capacity Available** (yd^3)	Hand Excavation Required (yd^3)
	Lumber Version of Small Pole	Shored-Trench Stoop-in	Log-Covered Trench				
Paris	0	140	388	6,738	-	0	6,738
Bridgewater	43	588	0	16,922	Marshall	2,046	14,876
Sangerfield	266	0	0	12,289	Sangerfield	4,600	7,689
Augusta	0	0	0	0	-	0	0
Marshall	0	10	0	254	-	254	0
Verona	0	1,126	1,626	41,934	-	0	41,934
Florence	0	0	240	1,968	Camden	1,049	919
Camden	0	0	555	4,551	Camden	4,551	0
Annsville	0	0	1,048	8,594	Annsville	7,900	694
Vienna	0	0	1,910	15,662	Vienna	2,300	13,362
Western	0	0	1,655	13,571	Boonville	13,571	0
Lee	0	0	3,339	27,380	Ava, Boonville	5,771	21,609
Ava	0	0	68	558	-	558	0
Boonville	0	0	0	0	-	0	0
Forestport	0	0	0	0	-	0	0
Vernon	16	144	3,256	31,096	Vernon	16,100	14,996
Steuben	0	0	0	0	-	0	
Ramsen	37	177	1,187	15,939	Steuben	2,300	13,639
Trenton	142	8	6,514	60,178	Trenton	7,900	52,278
Total	504	2,193	21,786	257,634	-	68,900	188,734

*The capacity of each expedient shelter is: lumber version of small pole - 12, shored-trench stoop-in 4, log-covered trench - 4.

†The excavation requirement of each expedient shelter is: buried lumber version of small pole - 46.2 yd^3, shored-trench stoop-in - 25.4 yd^3, log-covered trench - 8.9 yd^3.

**Assuming available earthmoving equipment operates 40 hours.

excavation resulted in equipment being assigned to expedient shelters in the following order:

1. shored-trench stoop-in
2. lumber version of small pole
3. log-covered trench

Although the above priority system does not maximize the number of expedient shelters that can be mechanically excavated, it should lead to an efficient utilization of available excavation resources. Earthmoving equipment should be effectively utilized because transportaton between individual shelter sites should be minimized. Also, although more hand excavation is required by this scheme than would be required by other allocation schemes, the quantity of excavation per shelter (per person) is reduced, which should lead to an efficient utilization of hand excavation resources.

Table 25 displays the allocation of earthmoving equipment capacity to specific types of expedient shelter by township that resulted from applying this two-step allocation scheme. It can be seen that 5,848 log-covered trench shelters (lowest priority) are scheduled for mechanical excavation ahead of 1,859 shored-trench stoop-in and 246 lumber version of small pole shelters. This scheduling paradox occurred because of the allocation of earthmoving equipment to townships adjacent to their source township, without regard to the location of the highest priority shelters. This seemingly undesirable result suggested that earthmoving equipment should be allocated to townships on the basis of the location of the higher priority expedient shelters, without regard to the transportation involved in moving the equipment from the source township. However, a closer examination of the distribution of earthmoving equipment versus the location of the shored-trench stoop-in and lumber version of small pole shelters in Oneida

TABLE 25. ALLOCATION OF EARTHMOVING EQUIPMENT CAPACITY TO TYPES OF EXPEDIENT SHELTER

Host Township	Total Excavation Capacity Available	Number of Expedient Shelters Mechanically Excavated			Number of Expedient Shelters Excavated by Hand		
		Shored-Trench Stoop-in	Lumber Version of Small Pole	Log-Covered Trench	Shored-Trench Stoop-in	Lumber Version of Small Pole	Log-Covered Trench
Paris	0	0	0	0	140	0	388
Bridgewater	2,046	81	0	0	507	43	0
Sangerfield	4,600	0	100	0	0	166	0
Marshall	254	10	0	0	0	0	0
Verona	0	0	0	0	1,126	0	1,626
Florence	1,049	0	0	127	0	0	113
Camden	4,551	0	0	555	0	0	0
Annsville	7,900	0	0	962	0	0	186
Vienna	2,300	0	0	280	0	0	1,630
Western	13,571	0	0	1,655	0	0	0
Lee	5,771	0	0	702	0	0	2,637
Ava	558	0	0	68	0	0	0
Vernon	16,100	144	16	1,424	0	0	1,832
Remsen	2,300	91	0	0	86	37	1,187
Trenton	7,900	8	142	139	0	0	6,375
Total	68,900	334	258	5,912	1,859	246	15,882

County revealed that almost half of the total earthmoving capacity was located in the northeastern townships which required only about 19 percent of the total available earthmoving capacity, whereas 10 percent of the total capacity was located in the southernmost townships which required 35 percent of the total capacity. Since the transportation of earthmoving equipment would be much more complex and time consuming if the equipment were allocated strictly on a priority basis, no such allocation scheme was developed by RTI. Although a strict priority allocation scheme does not appear to be feasible in the Utica-Rome host area, it may lead to an efficient utilization of excavation resources in host areas where the earthmoving equipment is not so widely separated from the highest priority shelters.

5. Summary

This section summarizes the final shelter posture developed for Oneida County, New York. For each host township, the summary includes the hosted population, the number of existing and upgradable shelter spaces, the source of lumber and earthmoving equipment, and the allocation of lumber and earthmoving equipment to specific shelter sites. Each township summary includes a table that lists all of the NSS and upgradable facilities in the township along with their available shelter spaces and associated lumber requirements. Upgradable facilities are categorized as either upgradable Type I or upgradable Type II. Upgradable Type I facilities are those with soil available on-site. Upgradable Type II facilities require the transportation of soil to the site from a borrow pit. Some of the upgradable facilities also contain existing shelter spaces. These existing spaces are listed under "shelter spaces"; no distinction is made between existing spaces and upgradable spaces in facilities which have both types of spaces.

a. Paris Township

Paris Township will host a total of 13,466 people. Of this total, 1,250 people will be sheltered in existing buildings which do not require upgrading and 10,107 people will be sheltered in upgraded buildings; this leaves a requirement for 2,109 expedient shelter spaces.

Table 26 contains a listing of existing shelter facilities in Paris Township and shows the number of shelter spaces and the lumber requirement for each shelter. The lumber for upgrading will be provided from the source in Sangerfield Township. Two front-end loaders for performing the upgrading earthwork will be provided from Bridgewater Township.

TABLE 26. EXISTING SHELTER FACILITIES AND LUMBER REQUIREMENTS: PARIS TOWNSHIP

Facility Class	Facility Name	Facility Number	Shelter Spaces	2" Lumber (lf)	Plywood (Sheets)
NSS	Concel Paper Co.	00753	1,250	0	0
Type I	Sauquoit Val. Cen. Sch.	00749	2,021	2,200	82
	Kelsey Hayes Bldg.1	00860	2,886	4,125	86
	Kelsey Hayes Bldg.2	00751	1,200	4,000	34
	Sauquoit Val. Elem. Sch.	02233	4,000	6,225	101
		Total	11,357		

The requirement for expedient shelter spaces can be filled by constructing 140 shored-trench stoop-in shelters and 388 log-covered trench shelters. All of the lumber from the lumber company in Paris Township will be used to construct the 140 hand-excavated shored-trench stoop-in shelters (which will provide 560 spaces). These shelters should all be built at one

site to facilitate the distribution of lumber to the individual shelters. The 388 hand-excavated log-covered trench shelters should be located in large groups, preferably in fields adjacent to stands of timber that can be used as a source of logs. No earthmoving equipment will be available for expedient shelter excavation in Paris Township.

b. Bridgewater Township

Bridgewater Township will host a total of 3,673 people. There are 319 shelter spaces available in existing NSS facilities and 493 shelter spaces available in upgradable shelters; this leaves a requirement for 2,866 expedient shelter spaces.

Table 27 contains a listing of existing shelter facilities in Bridgewater Township and shows the number of spaces available and the lumber requirements for each shelter.

TABLE 27. EXISTING SHELTER FACILITIES AND LUMBER REQUIREMENTS: BRIDGEWATER TOWNSHIP

Facility Class	Facility Name	Facility Number	Shelter Spaces	2" Lumber (lf)	Plywood (Sheets)
NSS	Milk Co.	1320C	79	0	0
	Elem. Sch.	1321C	140	0	0
	Milk & Cream Co.	1343C	100	0	0
Type I	Faith Chapel	1455C	144	0	2
Type II	Book Store	1426C	37	0	1
	White Eagle Lodge	1427C	72	0	1
	Western Star Lodge	1428C	160	0	1
	Store-Apts.	1430C	80	0	1
		Total	812		

The lumber for upgrading will be provided from the source in Sangerfield Township. The earthmoving equipment for performing the upgrading earthwork will be provided from within Bridgewater Township. One grader for excavation and one front-end loader to load dump trucks will be used at a borrow pit to supply soil for the Type II shelters. One front-end loader will be needed to upgrade the Type I shelters and place the soil at the Type II shelters.

The requirement for expedient shelter spaces can be filled by constructing 43 lumber version of small pole shelters and 588 shored-trench stoop-in shelters. Lumber from the source in Sangerfield Township will be provided to construct these shelters. A gradall with the capacity to excavate 81 of the shored-trench stoop-in shelters will be provided from Marshall Township. All of the remaining expedient shelters must be excavated by hand. The 81 mechanically-excavated shored-trench stoop-in shelters should be located at one site, if possible, to minimize the transportation of the gradall. The remaining expedient shelters should be located in large groups to facilitate the distribution of lumber to the individual shelters.

c. Sangerfield Township

Sangerfield Township is to host a total of 7,751 people. There are 2,494 spaces available in existing NSS buildings and 2,062 spaces available in upgradable buildings; this leaves a requirement for 3,195 expedient shelter spaces.

Table 28 contains a listing of existing shelter facilities in Sangerfield Township and shows the number of spaces and the lumber requirement for each shelter. The lumber for upgrading will be provided from within the township. The earthmoving equipment for upgrading will also

TABLE 28. EXISTING SHELTER FACILITES AND LUMBER REQUIREMENTS: SANGERFIELD TOWNSHIP

Facility Class	Facility Name	Facility Number	Shelter Spaces	2" Lumber (1F)	Plywood (Sheets)
NSS	Candee Bldg. 111	1393C	386	0	0
	Stores - Apts.	1394C	514	0	0
	Hotel	1404C	94	0	0
	Dept. Store	1406C	195	0	0
	High School	1412C	700	0	0
	Nursing Home	1413C	192	0	0
	Bank	1421C	149	0	0
	Store - Apts.	1422C	58	0	0
	Store	1423C	89	0	0
	Restr. - Apts.	1424C	63	0	0
	Stores - Apts.	1425C	54	0	0
Type I	Mobil Station	1383C	73	0	28
	Bowling Ctr.	1390C	250	0	9
	Lewis Co.	1391C	336	1200	38
	Store - Apts.	1403C	74	0	6
	Church	1405C	320	0	5
	Auction Glry.	1419C	450	0	17
	Church	1420C	150	0	8
Type II	Restaurant	1385C	32	0	1
	Store - Apts.	1414C	64	0	4
	Store - Apts.	1415C	64	0	0
	Sav. Loan	1416C	38	0	1
	Fire Dept.	1417C	211	400	0
		Total	4,556		

be provided from within Sangerfield Township. One grader for excavation and one front-end loader to load dump trucks will be used at a borrow pit to supply soil for the Type II shelters. Two front-end loaders will be needed to upgrade the Type I shelters and place the soil at the Type II shelters.

The requirement for expedient shelter spaces can be filled by constructing 266 lumber version of small pole shelters. Lumber to construct these shelters will be provided from the lumber company in Sangerfield Township. Two backhoes with the capacity to excavate the trenches for 100 of these shelters will be available in Sangerfield Township. The remaining 166 trenches must be excavated by hand. The mechanically-excavated shelters should be located in one group or in two groups of 50 in order to minimize the transportation of the backhoes. The remaining expedient shelters should be located in large groups in order to facilitate the distribution of lumber to the individual shelters.

d. Augusta Township

Augusta Township is to host a total of 3,326 people. All of these people can be accomodated in existing facilities; 107 people can be sheltered in existing NSS shelters and 3,219 people can be sheltered in upgradable shelters.

Table 29 contains a listing of existing shelter facilities in Augusta Township and shows the number of spaces and the lumber requirement for each shelter. Lumber for upgrading will be provided from the source in Sangerfield Township. Earthmoving equipment for upgrading will be provided from Augusta Township. One grader for excavation and one front-end loader to load dump trucks will operate a borrow pit to supply soil for the Type II shelters. Two front-end loaders will be employed at the shelter sites to upgrade the Type I shelters and to place soil around the Type II shelters.

TABLE 29. EXISTING SHELTER FACILITIES AND LUMBER REQUIREMENTS: AUGUSTA TOWNSHIP

Facility Class	Facility Name	Facility Number	Shelter Spaces	2" Lumber (lf)	Plywood (Sheets)
NSS	Elem. School	1319C	107	0	0
Type I	Hdwe. Store & Apts.	1080C	135	0	10
	Church	1081C	197	0	7
	Augusta Church	1186C	130	0	4
	Miner Ford	1187C	290	0	20
	Meth. Church	1193C	78	0	0
	High School	1317C	315	0	1
	Lily Wh. Bldg.	1318C	1,348	2,940	52
Type II	Village Hall	1082C	202	250	6
	IGA Store	1083C	260	750	15
	Hershey Mkt.	1188C	80	225	2
	Falls Phmcy.	1189C	28	0	2
	Bank & P. O.	1190C	78	0	1
	Falls Hotel	1192C	78	0	0
		Total	3,326		

e. Marshall Township

Marshall Township is to host a total of 749 people. Of this total, 710 people can be sheltered in the available upgradable shelter spaces. Expedient shelters must be constructed to accomodate the remaining 39 people.

Table 30 contains a listing of existing shelter facilities in Marshall Township and shows the number of shelter spaces available and the lumber requirements for each shelter. The lumber to be used in upgrading these facilities will be provided from the source in Sangerfield Township. One front-end loader to perform the upgrading earthwork will be available within Marshall Township.

TABLE 30. EXISTING SHELTER FACILITIES AND LUMBER REQUIREMENTS: MARSHALL TOWNSHIP

Facility Class	Facility Name	Facility Number	Shelter Spaces	2" Lumber (lf)	Plywood (Sheets)
Type I	Farm Products	1073C	464	2,080	16
	Hotel	1074C	141	0	9
	Supperette	1075C	105	0	1
		Total	710		

The requirement for expedient shelter spaces can be met by constructing 10 shored-trench stoop-in shelters. Lumber to construct these shelters will be provided from the lumber company in Sangerfield Township. The trenches for these shelters can be excavated by one gradall that is available in Marshall Township. All 10 shelters should be located at a single site in order to minimize the transportation of the gradall and to facilitate the distribution of lumber to the individual shelters.

f. Verona Township

Verona Township is to host a total of 14,226 people. There are 47 spaces available in existing NSS shelters and 3,172 spaces available in upgradable shelters, this leaves a requirement for 11,007 expedient shelter spaces.

Table 31 contains a listing of existing shelter facilities in Verona Township and shows the spaces available and the lumber requirements for each shelter. The lumber for upgrading will be provided from the source in Sangerfield Township. The earthmoving equipment for upgrading will be available in Verona. One grader for excavation and one front-end loader to load the dump truck will operate at a borrow pit until the soil required for the Type II shelters is delivered. The front-end loader will then be moved to the shelter sites to place the soil around the Type II shelters and to upgrade the Type I shelters.

TABLE 31. EXISTING SHELTER FACILITIES AND LUMBER REQUIREMENTS: VERONA TOWNSHIP

Facility Class	Facility Name	Facility Number	Shelter Spaces	2" Lumber (lf)	Plywood (Sheets)
NSS	Fire Sta.	1298C	27	0	0
	Verona H. Sch.	1301C	20	0	0
Type I	Church	1006C	100	750	2
	VVS School	1300C	2,107	0	2
	Church	1020C	170	450	8
	St. Peter Church	1021C	200	0	7
Type II	Ldry. & Unrs.	1048C	190	475	10
	Foodmart	1049C	405	1,125	22
		Total	3,219		

The requirement for expedient shelter spaces can be met by constructing 1,126 shored-trench stoop-in shelters and 1,626 log-covered trench shelters. Lumber for constructing the 1,126 shored-trench stoop-in shelters will be provided from the source in Sangerfield Township. These shelters should be located in close proximity to each other, in one group if possible, to facilitate the distribution of lumber to the individual shelters. The 1,626 log-covered trench shelters should be located in large groups close to a source of logs. No earthmoving equipment will be available for expedient shelter excavation in Verona Township; therefore, all of the excavation must be done by hand.

g. Florence Township

Florence Township is to host a total of 1,380 people. There are 422 upgradable shelter spaces available; this leaves a requirement for 958 spaces in expedient shelters.

Table 32 contains a listing of existing shelter facilities in Florence Township and shows the spaces available and the lumber requirements for each shelter.

TABLE 32. EXISTING SHELTER FACILITIES AND LUMBER REQUIREMENTS: FLORENCE TOWNSHIP

Facility Class	Facility Name	Facility Number	Shelter Spaces	2" Lumber (lf)	Plywood (Sheets)
Type I	St. Mary Church	1218C	70	0	1
	Tavern	1223C	116	0	5
	Village Hall	1228C	124	0	3
	Grove Hotel	1229C	112	150	2
		Total	422		

Lumber for upgrading will be provided from the source in Boonville Township. One front-end loader for performing the upgrading earthwork will be provided from Florence Township. The requirement for expedient shelter spaces can be filled by constructing 240 log-covered trench shelters.

Since there will be no lumber available for expedient shelter construction in Florence Township, log-covered trenches must be utilized. A shovel with the capacity to excavate 127 of these shelters will be provided from Camden Township. The remainder must be excavated by hand. The 127 mechanically-excavated, log-covered trenches must be located in one group to effectively utilize the shovel. All of the log-covered trench shelters should be close to a source of logs.

h. Camden Township

Camden Township is to host a total of 11,178 people. There are 3,677 spaces available in existing NSS shelters and 5,181 spaces available in upgradable shelters; this leaves a requirement for 2,220 expedient shelter spaces.

Table 33 contains a listing of existing shelter facilities in Camden Township and shows the spaces available and the lumber requirements for each shelter. Lumber for upgrading will be provided from a source in Boonville Township. The earthmoving equipment for upgrading will be provided from Camden Township. One grader for excavation and one front-end loader for loading dump trucks will operate from a borrow pit to supply the soil required for the Type II shelters. Three front-end loaders should be employed at the shelter sites to upgrade the Type I shelters and to place the soil around the Type II shelters.

There is no lumber available for constructing expedient shelters; therefore, the requirements for expedient shelter spaces must be met by

TABLE 33. EXISTING SHELTER FACILITIES AND LUMBER REQUIREMENTS: CAMDEN TOWNSHIP

Facility Class	Facility Name	Facility Number	Shelter Spaces	2" Lumber (lf)	Plywood (Sheets)
NSS	Envelope Co.	1257C	107	0	0
	Tire Store	1258C	89	0	0
	Stores - Off.	1259C	160	0	0
	Bank	1260C	297	0	0
	Snow Shoe Inn	1261C	116	0	0
	Restr. - Apts.	1262C	73	0	0
	Hdwr. Store - Apts.	1264C	72	0	0
	Store - Apts.	1267C	85	0	0
	Stores - Off.	1269C	96	0	0
	Stores	1271C	163	0	0
	Print Shop - Apts.	1272C	50	0	0
	Store - Apts	1274C	70	0	0
	Store - Apts.	1275C	83	0	0
	Store - Apts.	1276C	130	0	0
	Restuarant	1277C	129	0	0
	Adv. Journal	1279C	70	0	0
	Store - Apts.	1280C	75	0	0
	Tele. Bldg.	1282C	38	0	0
	Sch. Band Rm.	1283C	389	0	0
	Church	1286C	58	0	0
	R.C. Church	1287C	137	0	0
	Bank	1263C	102	0	0
	Stores - Apts.	1265C	60	0	0
	Gift Shop - Apts.	1266C	60	0	0
	Launderet - Apts.	1268C	59	0	0
	Store - Apts.	1270C	55	0	0
	Print Plnt.	1273C	10	0	0
	VFW - Apts.	1278C	97	0	0
	Town Hall	1288C	32	0	0
	Hme. for Adults	1289C	119	0	0
	Sch. Tunnel	1290C	36	0	0
	Elem. School	1291C	199	0	0
	Store & Apts.	1292C	70	0	0
	Church	1293C	33	0	0
	Western Auto Str.	1431C	170	0	0
	Store - Apts.	1432C	88	0	0
Type I	Library	1007C	83	0	1
	Wire Co. Bldg. 1	1003C	366	0	22
	Agway Supply	1008C	217	0	8
	Sunoco Sta. 3	1242C	62	0	11
	Laribee Mach. Co.	1248C	332	0	9
	Stamp Co. Bldg.	1281C	352	690	12
	Camden Mdl. Sch.	1285C	2,010	0	1
	Mobile Station	1294C	120	190	25

(Continued)

TABLE 33. EXISTING SHELTER FACILITIES AND LUMBER REQUIREMENTS: CAMDEN TOWNSHIP (Continued)

Facility Class	Facility Name	Facility Number	Shelter Spaces	2" Lumber (lf)	Plywood (Sheets)
Type I (Con't)	Camden Body Shop	1217C	330	2,275	23
	Church	1237C	42	420	1
	Car Wash	1240C	248	900	37
	Vacant Sch.	1245C	54	0	1
	Medical Bldg.	1255C	130	0	1
	Hme. for Aged	1371C	252	725	7
	McGee's Store	1251C	465	1,100	35
Type II	Insurance	1005C	70	0	0
	Diner	1250C	48	150	3
		Total	8,858		

constructing 580 log-covered trench shelters. One shovel and one gradall will be available in Camden Township with sufficient capacity to excavate all of the trenches. The gradall will be available full time and can excavate 314 of the trenches. These shelters should be located at one site, close to a source of logs. The shovel will be available to excavate the remaining 266 trenches before being transported to Florence Township. These shelters must be located at one site, preferably close to a source of logs.

i. Annsville Township

Annsville Township is to host a total of 4,336 people. Only 146 upgradable shelter spaces are available; the remaining 4,190 spaces must be provided by expedient shelters.

Table 34 contains a listing of existing shelter facilities in Annsville Township and shows the spaces available and the lumber requirements for each shelter. The lumber for upgrading will be provided from a source in Boonville Township. One front-end loader for performing the upgrading earthwork will be available in Annsville Township.

TABLE 34. EXISTING SHELTER FACILITIES AND LUMBER REQUIREMENTS: ANNSVILLE TOWNSHIP

Facility Class	Facility Name	Facility Number	Shelter Spaces	2" Lumber (lf)	Plywood (Sheets)
Type I	Bill's Groc.	1215C	56	0	1
	Pine Hill Inn	1222C	90	0	1
		Total	146		

The requirement for expedient shelter spaces can be filled by constructing 1,048 log-covered trench shelters. There is no lumber available for expedient shelter construction. Two shovels and a backhoe

with sufficient capacity to excavate 962 of these shelters will be available in Annsville Township. The mechanically-excavated shelters must be located in three groups; two having at least 341 shelters (the number to be excavated by each shovel) and another group at least 280 shelters (excavated by the backhoe). All groups should be close to a source of logs. The remaining 86 shelters must be excavated by hand.

j. Vienna Township

Vienna Township is to host a total of 8,999 people. There are 90 shelter spaces available in existing NSS shelters and 1,270 shelter spaces available in upgradable shelters; this leaves a requirement for 7,639 expedient shelter spaces.

Table 35 lists the existing shelter facilities in Vienna Township and shows the spaces available and the lumber requirements for each shelter. The lumber for upgrading will be provided from the source in Sangerfield Township. Two front-end loaders for performing the upgrading earthwork will be available in Vienna Township.

TABLE 35. EXISTING SHELTER FACILITIES AND LUMBER REQUIREMENTS: VIENNA TOWNSHIP

Facility Class	Facility Name	Facility Number	Shelter Spaces	2" Lumber (lf)	Plywood (Sheets)
NSS	Sand Co.	1296C	90	0	0
Type I	Dellomorte	1178C	420	1,685	11
	Harden Furn. Whse.	1216C	850	12,745	9
		Total	1,360		

No lumber will be available in Vienna Township for expedient shelter construction; therefore, the requirement for expedient shelter spaces must

be filled by constructing 1,910 log-covered trench shelters. One backhoe with sufficient capacity to excavate 280 of the trenches will be available in Vienna Township. These 280 shelters should be located in one group, preferably close to a source of logs. The remaining shelters should be constructed in groups close to a source of logs.

k. Western Township

Western Township is to host a total of 6,618 people. Since there are no existing shelter facilities in Western Township, expedient shelter spaces must be provided for these people.

No lumber will be available in Western Township; therefore, the requirement for expedient shelter spaces must be met by constructing 1,655 log-covered trench shelters. Three shovels and three backhoes will be provided from Boonville Township to excavate the trenches. The shelters must be located in six groups as follows: three groups of 341 shelters each (one shovel can excavate 341 trenches), two groups of 280 shelters each (280 trenches per backhoe), and one group of 72 shelters. The backhoe used to excavate this last group will be transported to Ava Township when the excavation is completed. All of the shelter sites should be close to sources of logs.

l. Lee Township

Lee Township is to host a total of 19,468 people. There are 6,113 shelter spaces available in upgradable facilities; this leaves a requirement for 13,355 expedient shelter spaces.

Table 36 contains a listing of the existing upgradable shelter facilities in Lee Township and shows the space available and the lumber requirements for each shelter. The lumber for upgrading will be provided from a source in Boonville Township. Five front-end loaders for performing the upgrading earthwork will be provided from Annsville Township.

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TABLE 36. EXISTING SHELTER FACILITIES AND LUMBER REQUIREMENTS: LEE TOWNSHIP

Facility Class	Facility Name	Facility Number	Shelter Spaces	2" Lumber (lf)	Plywood (Sheets)
Type I	Henry Bldg.	01459	240	2,250	25
	Pie Stand Rest.	01460	135	750	15
	KwikFoods & Stores	01461	300	1,750	23
	Pizza - Stores	01462	150	375	15
	Arco Service Sta.	01466	56	200	8
	Delta Methodist Church	01468	300	1,500	21
	Speakers Ctge. C & MAC	01479	85	250	11
	Stores Lee Fair Groc.	01486	170	400	15
	St. Andrews Epscpl. Ch.	01489	320	2,500	27
	Jeroszko Lumber Co.	01491	70	250	10
	Mobil Service Sta.	01493	50	175	8
	J & L Country Store	01494	50	275	2
	Rome Water Plt. Garage	01499	60	175	8
	Rome Water Trt. Plt. 1A	01500	63	175	9
	St. Joseph Church	01501	168	400	0
	St. Joseph Parish Ctr.	01502	180	400	9
	Fire Sta. Twp. Lee	01503	190	700	15
	Greg Ellinger Auto Repr.	01504	420	1,500	27
	Methodist Ch.	01506	331	1,750	23
	Lee Center Inn	01507	20	400	1
	Lee Legion Post 1794	01508	120	350	8
	Yawobski Restaurant	01512	90	825	0
	Nellenbachs Hofrau	01516	90	250	11
	Quaker Bldg.	01517	35	125	2
	Stokes School	03758	2,420	21,375	74
		Total	6,113		

No lumber will be available for expedient shelter construction in Lee Township; therefore, the requirement for expedient shelter spaces must be met by constructing log-covered trench shelters. For excavation work, one backhoe will be provided from Boonville Township and another will be transported from Western Township upon completion of the excavation in Western Township. Also, one backhoe will be transported from Ava Township upon completion of the excavation in that township. The mechanically-excavated shelters must be located in three groups as follows: one group of 280 shelters (one backhoe from Boonville Township working full time), one group of 210 shelters (one backhoe from Western Township working part-time) and one group of 212 shelters (one backhoe from Ava Township working part-time). All remaining shelters must be manually excavated and may be grouped as necessary based on the available shelter sites. All of the log-covered trench shelters should be located close to a source of logs.

m. Ava Township

Ava Township is to host a total of 314 people. One upgradable facility will be available with 44 shelter spaces; this leaves a requirement for 270 expedient shelter spaces.

Table 37 lists the Type I building and shows the spaces available and the lumber requirements for that shelter. The lumber for upgrading will

TABLE 37. EXISTING SHELTER FACILITIES AND LUMBER REQUIREMENTS: AVA TOWNSHIP

Facility Class	Facility Name	Facility Number	Shelter Spaces	2" Lumber (lf)	Plywood (Sheets)
Type I	Methodist Church	1001C	44	0	3
		Total	44		

be provided from a source in Boonville Township. A front-end loader for performing the upgrading earthwork will be available in Ava Township.

No lumber will be available in Ava Township for expedient shelter construction; therefore, the required expedient shelter spaces will be obtained by constructing 68 log-covered trench shelters. One backhoe (available in Ava Township) will be used to excavate the trenches for these shelters and will then be transported to Lee Township. The shelters should be located in one group, preferably close to a source of logs.

n. Boonville Township

Boonville Township will host a total of 6,291 people. Of this total, 3,840 people will be sheltered in existing NSS shelters and 2,451 people will be sheltered in upgradable buildings. No expedient shelters will be needed.

Table 38 lists the existing shelter facilities and lumber requirements in Boonville Township. The lumber for upgrading will be provided from two sources within Boonville Township. The earthmoving machinery for upgrading is also available within Boonville Township. One grader for excavating and one front-end loader to load dump trucks will operate from a borrow pit to provide soil for the Type II shelters. The remaining two front-end loaders will be used on-site to upgrade the Type I shelters and to place the soil around the Type II shelters.

o. Forestport Township

Forestport Township will host a total of 1,401 people. Of this total, 791 people will be sheltered in existing NSS shelter spaces and 610 people can be sheltered in upgradable buildings. No expedient shelters will be needed.

TABLE 38. EXISTING SHELTER FACILITIES AND LUMBER REQUIREMENTS: BOONVILLE TOWNSHIP

Facility Class	Facility Name	Facility Number	Shelter Spaces	2" Lumber (lf)	Plywood (Sheets)
NSS	Post Office	1342C	306	0	0
	Stores - Apts.	1344C	64	0	0
	Western Auto	1345C	70	0	0
	Store - Apts.	1347C	90	0	0
	Restr. - Apts.	1348C	93	0	0
	Store - Off.	1349C	50	0	0
	Stores - Apts.	1350C	64	0	0
	Stores - Apts.	1351C	70	0	0
	Ward Store - Apts.	1352C	315	0	0
	Stores - Apts.	1353C	209	0	0
	Hdwr. Store	1354C	64	0	0
	Store - Apts.	1355C	83	0	0
	Store - Apts.	1356C	11	0	0
	Restr. - Apts.	1357C	90	0	0
	Furn. Store	1358C	72	0	0
	Stores - Apts.	1359C	75	0	0
	Groc. Store	1360C	73	0	0
	Park Hotel	1362C	54	0	0
	Baptist Church	1363C	445	0	0
	St. Joseph Church	1364C	18	0	0
	Store	1365C	368	0	0
	Store	1367C	149	0	0
	Tele. Bldg.	1368C	317	0	0
	Bank	1433C	182	0	0
	Library	1435C	130	0	0
	Hotel	1442C	80	0	0
	Barber - Apts.	1446C	60	0	0
	Bank	1448C	160	0	0
	Apartments	1459C	78	0	0
Type I	Insurance Office	1114C	64	0	1
	Sunoco Station	1121C	72	500	17
	Church	1127C	132	275	4
	Restaurant	1445C	120	0	6
	Herald	1361C	75	0	3
	Nursing Home	1443C	158	0	1
	Coswell Whse.	1444C	160	0	27
	Central School	1447C	928	2,000	5
	Knights of Columbus	1449C	144	0	11
	Baileys Boonville Mill	1441C	95	0	1
Type II	Gift Shop - Apts.	1346C	142	0	0
	Store - Apts.	1366C	72	0	9
	Hulbert House	1434C	218	0	9
	Chbr. of Commerce	1440C	71	0	13
		Total	6,291		

Table 39 lists the existing shelter facilities in Forestport Township and shows the spaces available and the lumber requirements for each shelter. The lumber for upgrading will be provided from a source in Boonville Township. One front-end loader to perform the upgrading earthwork will be available within Forestport Township.

p. Vernon Township

Vernon Township will host a total of 31,312 people. Of this total, 614 people will be sheltered in existing NSS shelters and 16,911 will be sheltered in upgradable buildings; this leaves a requirement for 13,787 expedient shelter spaces.

Table 40 contains a listing of existing shelter facilities in Vernon Township and shows the spaces available and the lumber requirements for each shelter. The lumber for upgrading will be provided from the source in Sangerfield Township. The requirements for earthmoving machinery will be satisfied within Vernon Township. One grader for excavation and one front-end loader to load dump trucks will operate from a borrow pit to provide soil for upgrading the Type II shelters. Seven front-end loaders will be employed at the shelter sites to upgrade the Type I shelters and to place the soil around the Type II shelters.

The requirement for expedient shelter spaces can be met by the construction of 16 lumber version of small pole shelters, 144 shored-trench stoop-in shelters, and 3,256 log-covered trench shelters. Lumber will be provided from a source within Vernon Township to construct the 16 lumber version of small pole shelters and the 144 shored-trench stoop-in shelters. One gradall and six backhoes will be available in Vernon Township for trench excavation. All of the shored-trench stoop-in shelters, all of the lumber

TABLE 39. EXISTING SHELTER FACILITIES AND LUMBER REQUIREMENTS: FORESTPORT TOWNSHIP

Facility Class	Facility Name	Facility Number	Shelter Spaces	2" Lumber (lf)	Plywood (Sheets)
NSS	Maggies Store	1324C	73	0	0
	Hotel Doyle	1325C	140	0	0
	Community Hall	1326C	141	0	0
	Shanks Store	1327C	92	0	0
	Hotel	1329C	76	0	0
	Gearys Store	1330C	105	0	0
	Fire House	1331C	64	0	0
	General Store - Apts.	1332C	100	0	0
Type I	Bywood Inn	1098C	100	0	1
	Church	1100C	100	250	1
	Episc. Church	1103C	175	0	4
	Fur Shop	1333C	67	0	14
	Dades Motel	1095C	144	0	2
	Farrs Restr.	1096C	24	0	2
		Total	1,401		

TABLE 40. EXISTING SHELTER FACILITIES AND LUMBER REQUIREMENTS: VERNON TOWNSHIP

Facility Class	Facility Name	Facility Number	Shelter Spaces	2" Lumber (lf)	Plywood (Sheets)
NSS	Sewage Treat. Plant	1303C	104	0	0
	Store - Apts.	1314C	262	0	0
	Village Inn	1315C	27	0	0
	Town Office Bldg.	1316C	24	0	0
	Hardware Store	1380C	60	0	0
	Wm. Wettel School	1381C	67	0	0
	Print Shop	1309C	70	0	0
Type I	Texaco Station	1161C	108	0	23
	American Legion Post	1163C	280	390	4
	Sherrill City Hall	1166C	100	0	13
	Cochran Mem. Presby. Ch.	1179C	241	210	4
	Oneida Castle Vill. Hall	1181C	192	0	4
	Oneida Ltd. Bldg. 3	1304C	4,500	4,585	45
	Oneida Ltd. Bldg. 41A	1306C	72	0	2
	Oneida Ltd. Bldg. 43	1307C	60	0	1
	Oneida Ltd. Powerhouse	1308C	425	2,125	19
	Oneida Ltd. Metal Shop	1373C	1,920	9,600	42
	Oneida Ltd. Design Bldg.	1374C	210	0	6
	Oneida Ltd. Bldg. 41	1375C	616	0	45
	Oneida Ltd. Bldg. 61B	1376C	128	200	1
	Oneida Castle Hotel	1379C	226	0	3
	Farm Mach. Building	1011C	288	0	7
	Harness House Rest.	1029C	70	220	0
	Grants Bldg. Supply	1040C	644	1,600	23
	Tiny's Diner	1041C	88	0	1
	Chevron Station	1054C	61	170	22
	Motel	1056C	34	0	0
	Barber - Apts.	1057C	94	0	1
	Vernon Fire Dept.	1058C	232	500	20
	Malecki Funeral Home	1059C	78	0	0
	Lenhart's Grocery	1061C	20	130	9
	Boat Restaurant	1063C	148	460	3
	Post Office - Shop	1064C	70	0	1
	National Bank of Vernon	1067C	35	0	1
	Charles Bois Hotel	1068C	77	0	1
	Exxon Station	1070C	277	0	15
	Perch Bar	1160C	103	360	2
	Hill Inn	1169C	70	0	3
	Plumbing Supply	1185C	171	0	7
	V.D. Grandstand	1183C	2,916	0	9
	V.D. Clubhouse	1184C	1,527	3,200	47
	Sconondoa Press	1313C	56	0	2
	Rexall Drug Store - P.O.	1451C	134	400	4

(Continued)

TABLE 40. EXISTING SHELTER FACILITIES AND LUMBER REQUIREMENTS: VERNON TOWNSHIP (Continued)

Facility Class	Facility Name	Facility Number	Shelter Spaces	2" Lumber (lf)	Plywood (Sheets)
Type II	Conde' Milking Equip.	1372C	41	0	1
	Top Hat Bar	1173C	75	0	0
	Laundromat	1027C	70	0	0
	Foodland Market	1042C	454	1,780	16
		Total	17,525		

version of small pole shelters, and 1,427 of the log-covered trench shelters can be mechanically excavated. To facilitate lumber distribution and to minimize machinery transportation, the shored-trench stoop-in and lumber version of small pole shelters should all be located at one site. This site will be served by two backhoes, one of which will work full time at this site and one of which will work part-time at this site and then be transferred to another site for a short amount of time. The second site receiving this backhoe should contain at least 304 log-covered trench shelters and should have another backhoe working full time. The remaining four backhoes should be employed at four sites, each having at least 280 log-covered trench shelters. The 1,829 shelters which are to be manually excavated may be grouped as necessary depending on the availability of sites. All of the log-covered trench shelters should be located close to a source of logs.

q. Remsen Township

Remsen Township will host a total of 8,781 people. Of this total, 382 people will be sheltered in existing NSS shelters and 2,496 people will be sheltered in upgradable buildings; this leaves a requirement for 5,903 expedient shelter spaces.

Table 41 contains a listing of the existing shelter facilities in Remsen Township and shows the shelter spaces available and the lumber requirements for each shelter. The lumber for upgrading will be provided from a source in Boonville Township. Two front-end loaders will be available in Remsen Township to perform the upgrading earthwork.

The requirement for expedient shelter spaces can be filled by constructing 37 lumber version of small pole shelters, 177 shored-trench stoop-in shelters, and 1,187 log-covered trench shelters. Enough lumber can

TABLE 41. EXISTING SHELTER FACILITIES AND LUMBER REQUIREMENTS: REMSEN TOWNSHIP

Facility Class	Facility Name	Facility Number	Shelter Spaces	2" Lumber (lf)	Plywood (Sheets)
NSS	Agway	1334C	54	0	0
	Antique Shop	1338C	140	0	0
	Country Store	1339C	103	0	0
	Luncheonette	1340C	64	0	0
	Evans Equip. Bldg.	1341C	21	0	0
Type I	WADR Radio Station	1089C	42	0	4
	OK Corral Rest.	1090C	84	0	2
	Gulf Station	1091C	50	0	1
	Marine Midland Bank	1209C	21	0	1
	Remsen Diner	1211C	70	0	1
	Dick's Boat Store	1213C	64	225	8
	Remsen Central School	1322C	1,266	2,600	29
	Grand Union	1323C	332	0	3
	Library	1335C	144	0	2
	Store - Apts.	1336C	73	0	2
	Remsen Highway Dept.	1411C	350	525	40
		Total	2,878		

be provided from the sources in Boonville Township to construct the 37 lumber version of small pole shelters and the 177 shored-trench stoop-in shelters. One backhoe to excavate 91 of the shored-trench stoop-in shelters will be provided from Steuben Township. These 91 shelters should all be located at one site. Ideally, all of the lumber version of small pole and shored-trench stoop-in shelters should be located at the same site to facilitate the distribution of lumber to individual shelters. The log-covered trench shelters, all of which will be manually excavated, may be grouped as dictated by the available construction sites, however, all of these shelters should be located close to a source of logs.

r. Trenton Township

Trenton Township will host a total of 28,472 people. Of this total, only 677 people will be sheltered in upgradable buildings, this leaves a requirement for 27,795 expedient shelter spaces.

Table 42 lists the existing shelter facilities in Trenton Township and shows the spaces available and the lumber requirements for each shelter.

TABLE 42. EXISTING SHELTER FACILITIES AND LUMBER REQUIREMENTS: TRENTON TOWNSHIP

Facility Class	Facility Name	Facility Number	Shelter Spaces	2" Lumber (lf)	Plywood (Sheets)
Type I	General Store	1128C	78	0	4
	Bar-Apts.	1130C	120	0	8
	Prospect Post Office	1131C	60	0	2
	Park Methodist Church	1132C	202	0	3
	Hotel Prospect	1133C	122	0	3
	Forest Lodge Apts	1369C	95	0	2
		Total	677		

Lumber for upgrading will be provided from a source within Trenton Township. One front-end loader can perform the upgrading earthwork and it also is available within Trenton Township.

The requirement for expedient shelter spaces can be provided by the construction of 142 lumber version of small pole shelters, 8 shored-trenched stoop-in shelters, and 6,514 log-covered trench shelters. Lumber will be provided from a lumber company within Trenton Township to construct the 142 lumber version of small pole shelters and the 8 shored-trench stoop-in shelters. A gradall, a trencher, and a shovel are available for shelter excavation in Trenton Township. The combined capacity of these items of equipment is sufficient to excavate trenches for all of the lumber version of small pole and shored-trench stoop-in shelters and 139 of the log-covered trench shelters. All of these shelters should be constructed at no more than three separate sites and they should have one item of equipment at each site. This will facilitate the distribution of lumber to individual shelters and minimize the transportation of earthmoving equipment. The remaining log-covered trench shelters which are to be excavated manually may be grouped to fit the available sites; however, all of these shelters should be located close to a source of logs.

B. Shelter Use Plan for the Macon, Georgia Host Area

1. Definition of Sheltered Population and Identification of Shelter Options

The existing host area plan for the Macon, Georgia host area contains an allocation plan describing the numbers of people to be moved out of the risk area into each host county. Table 43 summarizes the number of shelter spaces that are needed in each of the nine host counties. The shelter options to be utilized in each host county and the assignment of

people to individual shelters is also included in the existing host area plan for each of the nine host counties. The combination of existing NSS shelters and the upgradable buildings can provide sufficient shelter spaces to adequately protect both the resident and the relocated population in all nine counties. In the current study, RTI used those shelters that are included in the existing host area plan for the purposes of computing resource requirements and allocating materials and equipment for upgrading.

TABLE 43. POPULATION ALLOCATION IN THE MACON, GEORGIA HOST AREA

Host County	Resident Population	Relocated Population	Total Shelter Spaces Needed
Monroe	10,991	16,059	27,050
Dodge	15,658	10,509	26,167
Pulaski	8,066	8,565	16,631
Twiggs	8,222	4,057	12,279
Bleckley	10,291	17,144	27,435
Peach	15,990	26,514	42,504
Houston	17,348	22,079	39,427
Laurens	32,738	56,888	89,626
Baldwin	34,240	67,144	101,384
Total	153,544	228,959	382,503

2. Estimation of Resource Requirements for Upgrading

The lumber requirements for all of the upgradable shelter facilities in the Macon host area were computed using the methods described in Section III of this report. Table 44 displays the estimated lumber requirements by county and the total requirement for the host area. Soil requirements for upgrading are also shown in the table.

TABLE 44. RESOURCE REQUIREMENTS FOR UPGRADING IN MACON, GEORGIA HOST AREA

County	Soil (yd^3)		2" Lumber (lf)	Plywood (Sheets)
	Exterior Walls	Overhead		
Monroe	39,326	11,238	76,295	2,921
Dodge	37,636	8,695	54,510	1,719
Pulaski	32,908	13,289	49,532	1,796
Twiggs	20,589	5,045	29,590	1,332
Bleckley	32,586	10,311	39,115	1,168
Peach	16,405	4,457	33,105	1,348
Houston	46,403	21,703	157,520	1,808
Laurens	144,446	17,065	184,904	5,485
Baldwin	191,957	57,608	294,355	8,352
Total	532,256	149,411	918,926	25,929

3. Determine the Availability of Resources

RTI's original plan for determining the availability of lumber in the host area was to conduct a mail survey of all lumber companies and building supply dealers. This plan was not carried out because RTI was unable to obtain approval from the Federal Office of Management and Budget (OMB). This failure was due to conflicting survey requirements for other research efforts. Without OMB approval, RTI was limited to contacts with fewer than ten businesses. Two host counties (containing a total of nine lumber companies) were, therefore, selected as areas to be surveyed. Questionnaires were mailed to the lumber companies and a letter was sent to the local CD director asking for his help in encouraging the local lumber companies to cooperate in the study. The result of the survey in both

counties was that one questionnaire was returned by one of the companies in the mail survey.

Because of the absence of usable data covering the availability of lumber, RTI was unable to make a detailed evaluation of the adequacy of lumber in this host area. However, estimates as to the adequacy of the available lumber were made based on the data obtained from the Oneida County, New York lumber company survey and on the data in Table 45 (which shows the number of lumber companies identified in each Macon, Georgia host county through the yellow pages of local telephone directories).

TABLE 45. LUMBER COMPANIES, BY COUNTY, IN THE MACON, GEORGIA HOST AREA

Host County	Number of Lumber Companies
Monroe	3
Dodge	7
Pulaski	2
Twiggs	3
Bleckley	4
Peach	3
Houston	3
Laurens	13
Baldwin	5

The availability of lumber in Oneida County is shown in Table 11. The total available lumber for Paris, Sangerfield, and Trenton Townships represents average inventories of single lumber companies; the inventories of two lumber companies are represented by each of the totals for Boonville and Vernon Townships. Excluding the extremely large inventory in

Sangerfield Township, the average amounts of 2-inch lumber and plywood stocked by the remaining six lumber companies in Oneida County were, 79,000 linear feet of 2-inch lumber and 658 sheets of plywood. The average inventories of lumber reported by the one lumber company that responded to the mail survey were 100,000 linear feet of 2-inch lumber and 2,200 sheets of plywood: an inventory greater than the average inventories reported in Oneida County. Therefore, the estimates based on the Oneida County inventories may be conservative. Assuming that only the average amounts of lumber per lumber company in Oneida County would be available in the Macon host area, the expected availabilities of 2-inch lumber and plywood were generated for each county. Table 46 presents the expected lumber availabilities and the requirements for upgrading by county. A comparison

TABLE 46. EXPECTED AVAILABILITY OF LUMBER AND THE UPGRADING REQUIREMENT BY COUNTY IN THE MACON HOST AREA

County	Expected Availability		Upgrading Requirement	
	2" Lumber (lf)	Plywood (Sheets)	2" Lumber (lf)	Plywood (Sheets)
Baldwin	395,000	3,290	294,355	8,352
Laurens	1,027,000	8,554	184,904	5,485
Monroe	237,000	1,974	76,295	2,921
Bleckley	316,000	2,632	39,115	1,168
Twiggs	237,000	1,974	29,590	1,332
Pulaski	158,000	1,316	49,532	1,796
Dodge	553,000	4,606	54,510	1,719
Houston	237,000	1,974	157,520	1,808
Peach	237,000	1,974	33,105	1,348
Total	3,397,000	28,294	918,926	25,929

of the availabilities and requirements shows that the supply of 2-inch lumber should not be a problem in any county. Although the total supply of plywood appears to be sufficient, there are apparent local shortages in Baldwin, Monroe, and Pulaski Counties. For the purposes of this study, RTI assumed that the supplies of 2-inch lumber and plywood would be adequate; however, a complete survey of the Macon host area must be conducted before an accurate determination of the adequacy of the lumber supply can be made.

Because of the limited scope of the Oneida County survey with respect to hand tools, no attempt was made to estimate the supply of hand tools in the Macon host area on the basis of those results. As in the case of the Utica-Rome area, RTI feels that if the evacuees follow instructions to carry hand tools with them, the supply should be adequate to accomplish the upgrading.

The results of the pilot CRP Host County Critical Resources Survey were used to determine the availability of earthmoving equipment in the Macon host area. This survey was conducted in 1974 as a part of the pilot CRP Host Area Facility Survey. Critical resources are defined by this survey to be water facilities, sanitary facilities, food, and emergency equipment. Emergency equipment consists entirely of earthmoving equipment, with the exception of cranes and generators. Table 12 lists the types of emergency equipment surveyed and the code signifying each type.

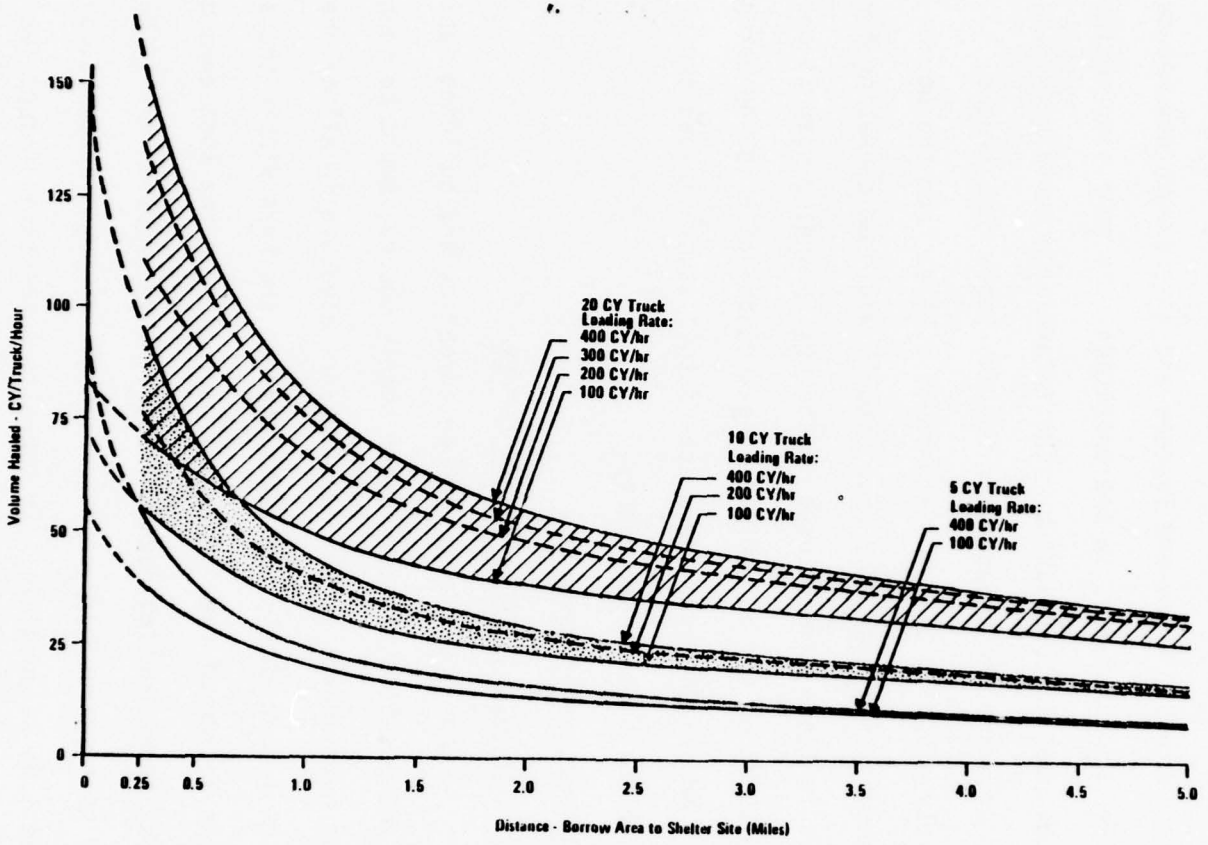
The pilot CRP Host County Critical Resources Survey was conducted in the Macon host area by county. An inventory of earthmoving equipment by county is useful because it enables the equipment to be allocated to shelters in the vicinity of their source. Table 47 contains a summary of available earthmoving equipment in eight of the nine host counties for

Macon, Georgia. No data are available for Baldwin County because it was added to the host area after the Critical Resources Survey was conducted. The available capacity of each type of earthmoving equipment, with the exception of dump trucks, was calculated using the production rates contained in Table 5. Front-end loaders and dozers were assumed to be used for excavation and placement in one operation, the remaining equipment was assumed to be used for excavation. The information contained in Figure 2 was used to estimate the capacity of the available dump trucks, conservatively assuming a haul distance of 5 miles from the borrow pit. It was also assumed that each unit of equipment would be operating for 60 hours. Data in Table 47 were used in the next planning step to determine equipment allocation and to estimate the adequacy of existing earthmoving equipment in Monroe County. The scope of this study limited the preparation of detailed plans to one host county.

4. Allocation of Resources

a. Allocation of Finished Lumber

After a survey of lumber companies and building suppliers is conducted, the position of each lumber supply source should be identified on a map of the host area. If the supplies are adequate in all of the host counties, the lumber should be distributed to shelters within the same county as the source of the lumber. If supplies in the host area are adequate, but some counties have shortages, then supplies should be distributed to neighboring counties while minimizing transportation distances as much as possible. If there is a shortage of supplies for the entire host area, then sources of lumber should be sought outside the host area or substitutions should be made.



Source: Wickham, George E., and Henry R. Tiedemann. Utilization of Equipment – Crisis Relocation Program. Technical Report No. 145. San Francisco, California: Jacobs Associates, September 1977.

Figure 2. Volume of Earth Hauled Versus Hauling Distance

TABLE 47. INVENTORY OF EARTHMOVING EQUIPMENT IN HOST COUNTIES FOR MACON, GEORGIA

Location	Earthmoving Equipment	Quantity	Capacity* (yd^3)
Monroe	Backhoe	5	29,700
	Grader	6	23,400
	Front-end loader	5	8,100
	Scraper	2	3,000
	Shovel	1	3,000
	Dozer	6	11,160
	Dump truck	19	12,540
Dodge	Backhoe	3	13,200
	Clamshell	3	2,700
	Grader	10	49,800
	Front-end loader	3	6,500
	Scraper	7	11,400
	Dozer	10	21,960
	Dump truck	47	741,520
Pulaski	Backhoe	5	16,500
	Grader	3	17,100
	Front-end loader	7	13,100
	Dozer	5	13,200
	Dump truck	15	9,900
Twiggs	Backhoe	5	16,500
	Grader	10	49,800
	Front-end loader	21	48,400
	Scraper	14	25,200
	Dozer	18	50,160
	Dump truck	36	31,980
Bleckley	Backhoe	1	3,300
	Grader	5	26,400
	Front-end loader	2	3,700
	Scraper	1	1,200
	Dozer	4	8,160
	Dump truck	11	7,260
Peach	Backhoe	8	33,000
	Grader	3	11,700
	Front-end loader	3	9,800
	Scraper	2	2,400
	Dozer	4	7,800
	Dump truck	20	14,640

(Continued)

TABLE 47. INVENTORY OF EARTHMOVING EQUIPMENT IN HOST COUNTIES FOR MACON, GEORGIA (Continued)

Location	Earthmoving Equipment	Quantity	Capacity* (yd^3)
Houston	Backhoe	8	39,600
	Clamshell	1	900
	Grader	10	59,100
	Front-end loaders	10	16,900
	Scraper	6	9,000
	Dozer	4	7,920
	Dump Truck	29	26,160
Laurens	Backhoe	14	67,500
	Clamshell	1	900
	Grader	19	81,300
	Front-end loader	9	17,200
	Scraper	26	43,800
	Dozer	22	42,960
	Dump truck	68	54,900
Baldwin	Added to host area after critical resources survey completed.		

*Assuming heavy soil, each unit of equipment operating for 60 hours, excavation and placement in one operation by front-end loaders and dozers, excavation by other excavation equipment, and backhoes and shovel loading dump trucks for 5-mile hauls.

b. Allocation of Earthmoving Equipment

Table 48 presents a comparison of earthmoving requirements and available equipment capacities by county in the Macon host area. The Jacobs Associates' (Ref. 3) methodology (described under "General Approach") was used in calculating the earthmoving requirements. The "Excavate and Place" requirements (column 2 of Table 48) were calculated under the assumption that all of the earth required for berms would be excavated on-site and placed against ground floor walls in one operation by front-end loaders and dozers. The "Excavate Requirements" (column 4 of Table 48) were calculated under the assumption that all of the earth needed for shielding overhead would be excavated on-site by the earthmoving equipment that cannot be used for berm placement. Although these assumptions oversimplify the methods that would actually be employed (e.g., some facilities have basements), the requirements resulting from these calculations should give an indication of the adequacy of the available equipment to perform the earthmoving tasks.

An examination of Table 48 indicates that, although there would be an abundance of excavation capacity, there appears to be a shortage of earthmoving equipment capable of placing the earth berms against the walls. Twiggs County shows a sizable excess of capacity to perform all of the excavation and placement tasks, Peach County a small excess, and the remaining counties display insufficient capacities.

Because the scope of this study did not allow for a detailed allocation of earthmoving equipment in all of the Macon host counties, a detailed analysis was performed only on one county, Monroe County. Monroe County was chosen because the deficit of "excavate and place" capacity in the county is greater than 50 percent. Options identified for performing the earthwork in

TABLE 48. COMPARISON OF EARTHMOVING REQUIREMENTS AND AVAILABLE CAPACITIES BY COUNTY IN MACON, GEORGIA HOST AREA

County*	Excavate and Place (yd^3)†		Excavate (yd^3)**	
	Requirement	Capacity	Requirement	Capacity
Monroe	43,774	19,260	11,650	59,100
Dodge	39,368	28,460	11,396	77,100
Pulaski	32,908	26,300	13,289	33,600
Twiggs	20,589	98,560	5,045	91,500
Bleckley	32,586	11,860	10,311	30,900
Peach	16,405	17,600	4,457	47,100
Houston	46,403	24,820	21,703	108,600
Laurens	114,446	60,160	17,065	193,500
Total	346,479	287,020	94,916	641,400

*Baldwin County was added to the host area after the critical resources survey was completed.

†Assuming that all of the earth required for berms is excavated on-site and placed against ground floor walls in one operation by front-end loaders or dozers.

**Assuming that all of the earth required for shielding overhead is excavated on site by the earthmoving equipment that cannot be used for berm placement.

Monroe County can also be applied in other counties with deficits of earthmoving equipment.

Each of the following options discussed for Monroe County uses the Jacobs Associates' (Ref. 3) methodology for allocating equipment. By using this methodology, the upgradable buildings were classified as one of four types: single building with no basement, single building with basement, attached building with no basement, and attached building with basement. Based on RTI's survey of the buildings, it was determined that single buildings could be upgraded by using soil excavated on-site and that attached buildings would require soil from a borrow pit. The amount of soil needed for berm and for shielding overhead was calculated by summing the individual facility requirements within each classification of buildings.

The first option for performing the earthwork in Monroe County would be to employ the equipment available within the county in the same manner that equipment was allocated in Oneida County, New York, but with the restriction that no equipment from counties with excess capacities would be available in Monroe County. Table 49 displays a comparison of the earthmoving capacity available and the capacity required for each task involved under Option 1. Excavation and placement requirements for which there would be no machinery available would have to be met by hand.

A second option for performing the earthwork in Monroe County would be to use the front-end loaders and dozers only for placing the earth berms. All excavation, on-site as well as at the borrow pit, would be performed by the remaining earthmoving equipment. Table 50 presents a comparison of the available earthmoving capacity and the capacity required for each task involved under Option 2. Option 2 would not require excavation by hand, but almost 40 percent of the berm soil would be placed by hand.

TABLE 49. COMPARISON OF EARTHMOVING CAPACITY AVAILABLE VS. CAPACITY REQUIRED FOR OPTION 1 UPGRADING TASKS

Earthmoving Task	Requirement (yd^3)	Availability* (yd^3)
Excavate and place	42,861	19,260
Excavate on-site	11,005	29,400
Excavate and load at borrow pit	1,558	29,700
Place excavated soil	913	0

*Allocate front-end loaders and dozers to "Excavate and Place" and to place excavated soil; graders, scrapers, and shovel to excavate on-site operations, and backhoes to excavate and load dump trucks at borrow pit.

TABLE 50. COMPARISON OF EARTHMOVING CAPACITY AVAILABLE VS. CAPACITY REQUIRED FOR OPTION 2 UPGRADING TASKS

Earthmoving Task	Requirement (yd^3)	Availability* (yd^3)
Excavate on site	53,866	55,800
Excavate and load at borrow pit	1,558	3,300
Place excavated soil	43,774	26,520

*Allocate one backhoe to excavate and load at the borrow pit; the remaining backhoes, graders, scrapers, and shovel to excavate on-site and the front-end loaders and dozers to place the excavated soil.

The earthmoving requirements calculated for Monroe County are those that are needed to provide a total of 42,948 shelter spaces, allowing 10 square feet per person. However, only 27,050 shelter spaces will be needed to accomodate both the residents of and the people relocated to Monroe County. These people will actually be alloted more than 10 square feet per shelter space if all of the shelters are occupied. Therefore, a third option for performing the earthwork with the available earthmoving machinery would be to reduce the number of shelters utilized to the point that only 10 square feet per person would be allocated. This would be a reduction of 37 percent. Assuming that the earthmoving requirements would also be reduced by 37 percent (the reduction could be greater by eliminating shelters with relatively large soil requirements per space), the shortage of earthmoving capacity for placing excavated soil calculated in Option 2 could be reduced to slightly more than 1,000 cubic yards.

A fourth option for performing the earthwork in Monroe County would require the development of a detailed plan for the entire Macon host area. This option would involve the distribution of equipment from counties with excess earthmoving capacities to those counties with insufficient amounts of earthmoving equipment. The first step under this option would be to develop equipment allocations for each county by using only the equipment available in that county. Then, the requirements for particular types of equipment in some counties and the availabilities of particular types of equipment in other counties could be identified. The final step would be to match the requirements and availabilities while minimizing transportation time between counties. This option should result in a more efficient utilization of earthmoving equipment and in a reduced requirement for hand excavation and/or placement, but it would require detailed planning for the entire host area.

5. Summary

This section summarizes the shelter posture developed for Monroe County, Georgia. Monroe County will host a total of 27,050 people. Of this total 6,735 people will be sheltered in existing buildings which do not require upgrading and the remaining 20,315 people will be sheltered in upgraded buildings.

Table 51 contains a listing of the existing shelter facilities that are included in the Monroe County Crisis Relocation Plan. The 42,948 spaces were determined on the basis of 10 square feet per person. If all of the facilities were used, more space would be allocated per person for the 27,050 people actually to be sheltered.

The lumber for upgrading should be provided from sources in Monroe County. Insufficient amounts of earthmoving equipment are available in Monroe County to perform all of the earthwork. If no other equipment is made available, all of the excavation should be done with the five backhoes, six graders, two scrapers, and one shovel located in the county. The five front-end loaders and six dozers should be used only to place earth against the exterior walls. Hand placement of slightly more than 1,000 cubic yards of earth will be required.

TABLE 51. EXISTING SHELTER FACILITIES AND LUMBER REQUIREMENTS: MONROE COUNTY, GEORGIA

Facility Class	Facility Name	Facility Number	Shelter Spaces	2" Lumber (lf)	Plywood (Sheets)
NSS	Monroe Co. Courthouse	05101	1,351	0	0
	Monroe Co. Jail	05107	77	0	0
	Rexall Drug Store	05112	78	0	0
	U.S. Post Office	05114	235	0	0
	Monroe Pub. Library	05121	28	0	0
	Monroe Co. Hospital	05123	28	0	0
Type I	Monroe Acd. Clssrm. 1	2001C	1,178	2,100	30
	Monroe Acd. Gym.-Lib.	2002C	541	900	10
	Monroe Acd. Clssrm. 3	2003C	342	1,150	19
	Monroe Acd. Clssrm. 2	2004C	675	2,270	38
	Dodge Dealership	4132C	192	400	32
	Twistex Plant	4129C	2,250	13,000	30
	Mary Per. H.S. Bldg. 1	20061	270	0	11
	Mary Per. H.S. Bldg. 2	20062	2,505	4,850	21
	Mary Per. H.S. Bldg. 3	20064	1,666	1,340	190
	Mary Per. H.S. Bldg. 4	2006C	688	4,120	301
	Monroe Elem. School	2005C	1,635	720	6
	S. Dorm, Tift	6001C	1,127	0	59
	Monroe Dorm, Tift	6002C	1,236	0	63
	N. Dorm, Tift	6003C	1,127	0	59
	Lies Dorm, Tift	6004C	1,476	0	43
	Rutland St. Ctr., Tift	6005C	901	0	5
	Upshaw Hall, Tift	6006C	2,301	0	6
	Hardin Library, Tift	6007C	300	0	18
	Ponder Bldg., Tift	6008C	525	2,720	34
	Counseling Ctr., Tift	6010C	135	0	15
	Chapel, Tift	6012C	1,210	1,000	11
	Davis Brothers Motel	4168C	102	150	19
	Davis Brothers Motel	4169C	1,591	3,480	106
	Davis Brothers Motel	4170C	302	375	44
	Days Inn	4219C	720	1,800	90
	Days Inn	4224C	756	1,800	90
	Days Inn	4225C	756	1,800	90
	Red Carpet Motel	4217C	415	1,500	23
	Red Carpet Motel	4222C	720	1,920	72
	Red Carpet Motel	4223C	1,422	1,920	72
	Economy Inn	4204C	352	1,100	80
	Quality Inn	4199C	648	1,000	58
	Quality Inn	4200C	320	1,000	43
	Quality Inn	4201C	340	1,600	90
	Quality Inn	4203C	382	1,150	70
	Howard-Johnsons	4181C	1,232	2,940	165
	Days Lodge	4177C	680	1,600	36
	Days Lodge	4178C	680	0	36

(Continued)

TABLE 51. EXISTING SHELTER FACILITIES AND LUMBER REQUIREMENTS: MONROE COUNTY, GEORGIA (Continued)

Facility Class	Facility Name	Facility Number	Shelter Spaces	2" Lumber (lf)	Plywood (Sheets)
Type I (Con't)	Days Lodge	4179C	816	3,200	18
	Trade Winds Motel	4173C	1,488	0	189
	Johnson Ins. Agency	4193C	150	500	28
	Manufacturing Plant	4194C	272	0	6
	Hubbard El. Sch. Pt.3	20123	4,137	8,290	476
Type II	Stores N. Side Johnston	4178C	680	3,600	8
	Stores SW Crnr. Lee	4188C	400	1,000	12
	Total		42,948		

V. DISCUSSION AND EVALUATION OF RESULTS

During the course of this research effort a number of observations and conclusions were made by the RTI research team. This section discusses these observations and conclusions and presents recommendations concerning future work of this type.

The allocation of population to specific shelters is relatively straightforward and should not present any difficulties for local planners once the host area survey has been completed. In the two areas studied in this effort, the relocated population first goes to a reception point in the host area and then to an assigned shelter. RTI suggests that someone at each reception point have a list of the shelters and their capacities that are to be used by the people arriving at that reception point. This list could be used as a checklist to ensure that the correct number of people is assigned to each shelter. There is a degree of uncertainty as to the precise number of people who will arrive at each reception point because of spontaneous evacuation and other reasons. In areas where expedient shelters are to be used (such as Oneida County, New York), this list would also permit maximum utilization of shelters in existing buildings and thus minimize the use of expedient shelters.

RTI also suggests that upgrading plans for individual shelters be maintained at host area reception centers. As people are processed through these reception centers and assigned to specific shelters, the upgrading plan could be given to the designated shelter managers. This would ensure that the upgrading plan for each shelter is on-site when the upgrading is initiated.

The calculation of resource requirements in this study was made using data from available host area survey forms and supplemented by data obtained from a field visit to the facilities when necessary. The data on the survey forms were not collected for this purpose and, in general, are not considered very useful in this application. This means that an additional field visit to each facility is required to accurately compute the upgrading requirements. RTI recommends that the material requirements for upgrading be computed and an upgrading plan (including a sketch of the building) be prepared for each shelter during the survey teams' original visit to the facility. Guidelines similar to those given in Section III of this report could be incorporated into the survey instructions to aid the surveyors in performing these tasks. This procedure would eliminate the time and expense associated with a second visit to the shelter facilities.

RTI used two techniques in this study to identify the available lumber in a host area. In one county, an official of the local CD Office visited each lumber company in the county to request data on average lumber stocks. Data were obtained from all sources contacted in this county. In another county, a questionnaire was mailed to the five lumber companies identified. Only one company responded to this questionnaire. This experience implies that involvement of local personnel is very important to obtaining the cooperation of the business operators. In both cases, the lumber companies to be surveyed were identified from the yellow pages of local telephone directories. These directories were concluded to be adequate for identifying potential sources of lumber.

The availability of earthmoving equipment had already been obtained in the two study areas and was therefore not a problem to RTI. The data were obtained in 1974 when the original host area survey was conducted.

The allocation of both lumber and earthmoving equipment for shelter upgrading proved to be a relatively simple task once the requirements for these resources and their availability had been established. The allocation of lumber was made by identifying the locations of the lumber companies on a map of the host area and then defining a plan to distribute the lumber to the shelters nearest each source until either all of the lumber was used or until the requirements were filled. A similar procedure was used for earthmoving equipment. These procedures were concluded to be a reasonable way to allocate materials and equipment. In the implementation of these plans, it is important for each lumber company to have a list of the shelters that shows the lumber requirement for each shelter to be served by that company. Such a list would enhance the delivery of materials in an orderly manner.

Developing definitive plans for using new expedient shelters was one of the more difficult aspects of this study. RTI obtained soil surveys for the host area but was unable to determine if the soil would stand unsupported along trench walls. (The data in the soil surveys was not sufficiently detailed to make such a determination.) Many of the expedient shelter designs can be constructed as buried, semiburied, or aboveground; consequently, it may be feasible to specify the types of shelters to be built and have the decision made on-site as to how they are to be constructed. The shelters which use finished lumber were given first priority until all available lumber was used up. RTI feels that these shelters will be easier to construct than the other options and recommends that this priority scheme be followed in future planning efforts. Earthmoving equipment was also used for the earthwork required in expedient shelter construction to the extent that such equipment was available.

It was assumed that the sites chosen for the construction of expedient shelters would be sufficiently large to permit the construction of as many shelters as the equipment allocated to that site can excavate within the available time. This makes maximum use of the earthmoving equipment and greatly simplifies the delivery of materials. These procedures are also recommended for future planning efforts. Because of the inherent difficulties associated with the use of expedient shelters, RTI recommends that consideration be given to the use of private residences for shelter, where public shelters are not adequate to meet the needs.

Based on the experience gained during the development of shelter use plans under this effort, it is RTI's conclusion that, to have high confidence that these plans could be successfully implemented during a crisis, all of the planning work will need to be completed beforehand. The most time consuming part of the development of shelter use plans is the calculation of material and earthmoving requirements. RTI feels that it is particularly important that this part of the planning be completed before a crisis occurs. This implies that the data needed for making these calculations will also be developed. These data include the allocation of people and identification of the shelter options to be used. If these planning tasks are completed beforehand, and if there is a person available within each host county to immediately begin the completion of the shelter plans in the event of a crisis, RTI is reasonably confident that the plans could be successfully implemented. This means that the survey of available materials and equipment, the allocation of materials and equipment to specific shelters, and the implementation of the shelter plan would all need to be completed within a three-day period of time. This could be accomplished only if adequate personnel are immediately available to complete the plans.

VI. REFERENCES

1. Cristy, George A. Expedient Shelters Surveys. Final Report ORNL-4860. Oak Ridge, Tennessee: Oak Ridge National Laboratory, July 1973.

2. York, III, S. B., M. D. Wright, and E. L. Hill. Alternative Ways of Providing Host Area Fallout Protection. Final Report 44U-988. Research Triangle Park, North Carolina: Research Triangle Institute, December 1975.

3. Wickham, George E., and Henry R. Fiedemann. Utilization of Equipment - Crisis Relocation Program. Final Report No. 145. San Francisco, California: Jacobs Associates, September 1977.

4. Cristy, George A., and C. H. Kearny. Expedient Shelter Handbook. Final Report ORNL-4941. Oak Ridge, Tennessee: Oak Ridge National Laboratory, August 1974.

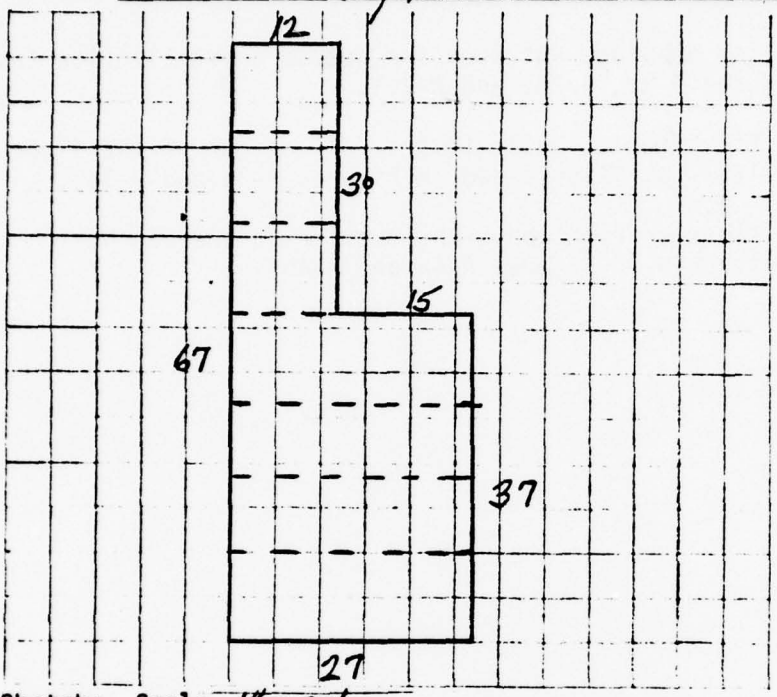
APPENDIX A

EXAMPLE SHELTER UPGRADING PLANS

SHELTER UPGRADING DATA FORM

Building Name Days Hardware SL 1672 1080C Fac. No. 140

Address 500' E of Cty 46 on S side of St. 12B Oriskany Falls



Sketch: Scale 1" = 20'

Upgrading Actions

2

3

4 (24")

See attached pages for definition of upgrading codes.

Shelter Story B

Spaces: Existing 0

Upgradable 135

Ventilation Requirement 4,350 cfm

Soil Requirement:

Exterior Walls	60	yd^3
Overhead		
(Flr.Abv.)	101	yd^3
(roof)	—	yd^3
Total	161	yd^3

Tools:

Saws	—
Picks	—
Axes	—
Hammers	—
Shovels	15

Materials:

2" lumber	—	lf
4" lumber	—	lf
Plywood	315	ft^2
Nails	—	lbs

Labor:

Carpentry	—	man-hours
Excavation	115	man-hours
Machine opr.		man-hours

Equipment _____ yd^3 hrs

UPGRADING ACTIONS

Code	Action
1	Install intermediate supports (as illustrated in Figure A-1) at the positions indicated on the shelter sketch.
2	Board up all exterior openings not used for access or ventilation (as illustrated in Figures A-2a, A-2b, and A-2c).
3	Place soil around all exterior walls to the full height of the floor or roof above the shelter (as illustrated in Figures A-3a and A-3b).
4	Place soil on the floor or roof above the shelter to the depth indicated (as illustrated in Figures A-4a and A-4b).

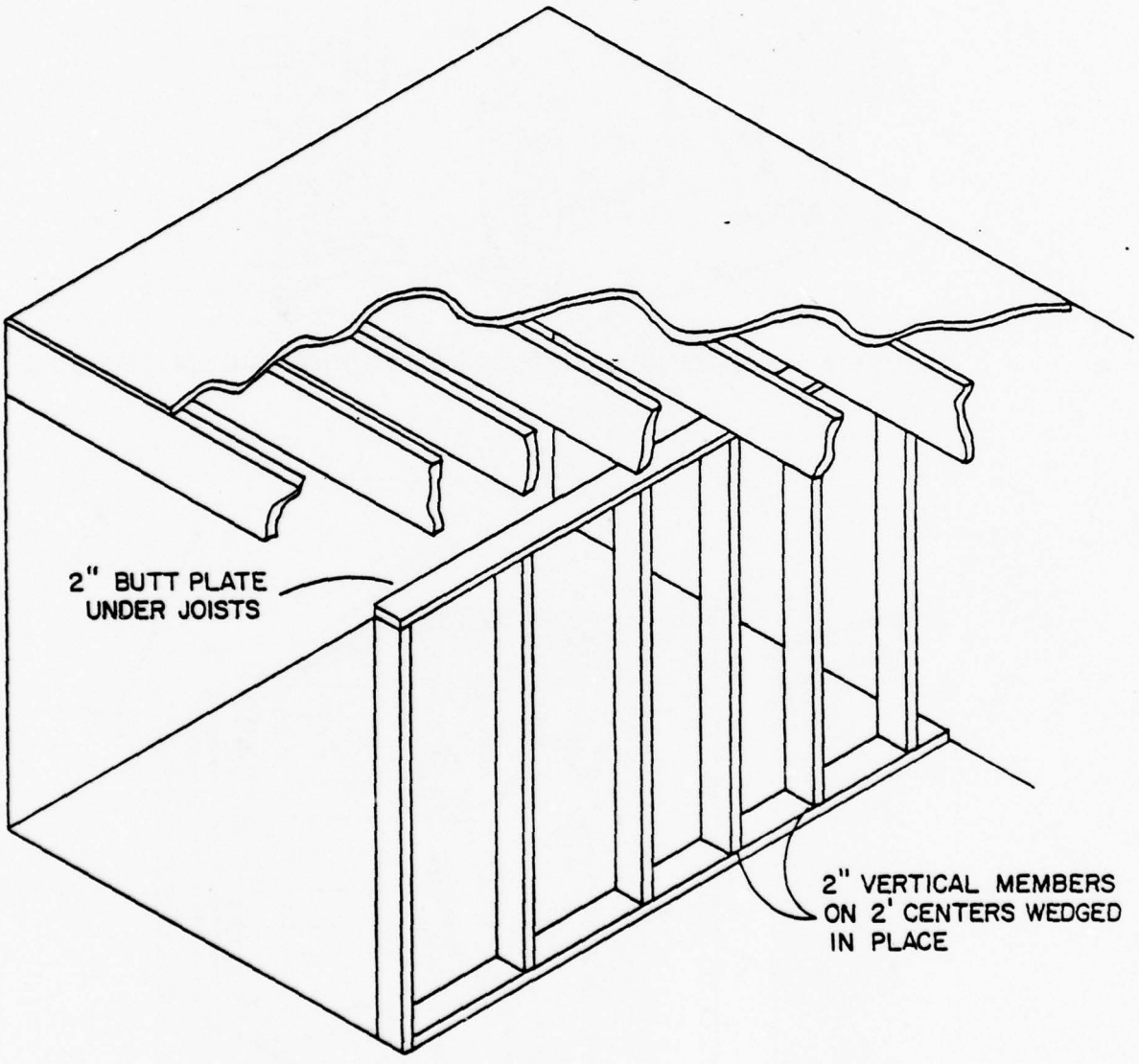


FIGURE A-1 ILLUSTRATION OF INTERMEDIATE SUPPORTS

FIGURE A-2a. PLACING BOARDS OVER EXTERIOR WALL APERTURES.

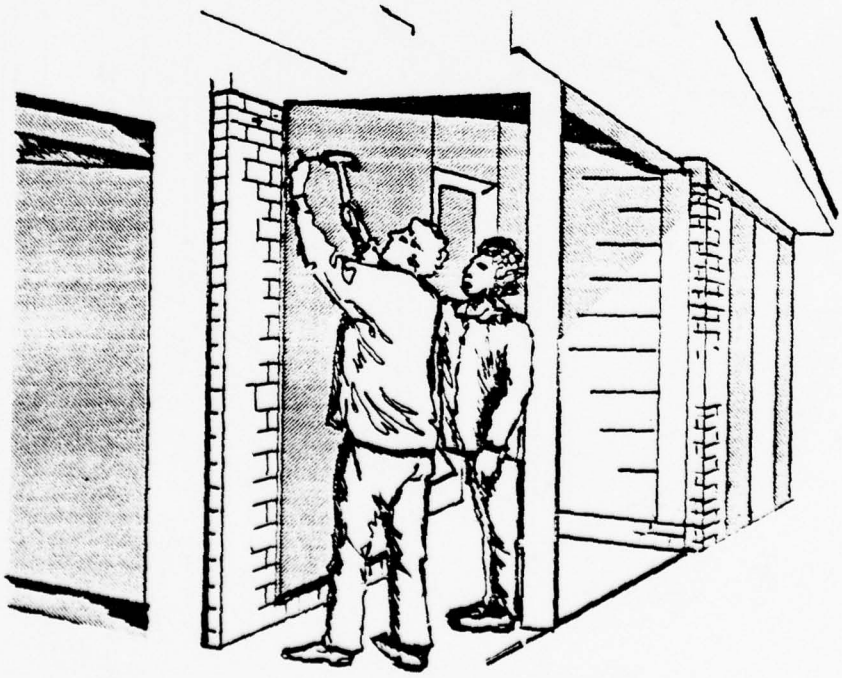


FIGURE A-2b. NAILING BOARDS IN PLACE.

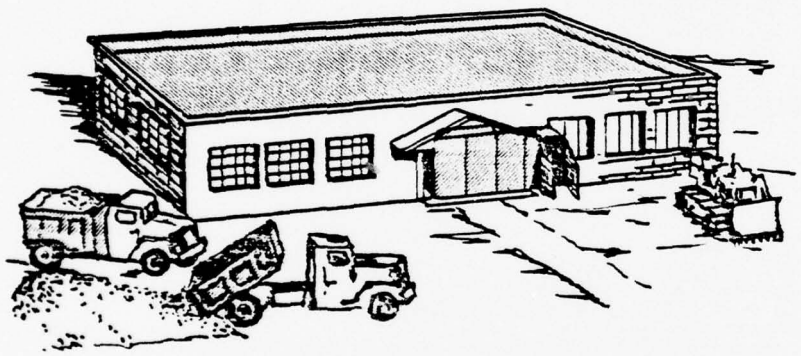


FIGURE A-2c. ILLUSTRATION OF BOARDED OPENINGS.

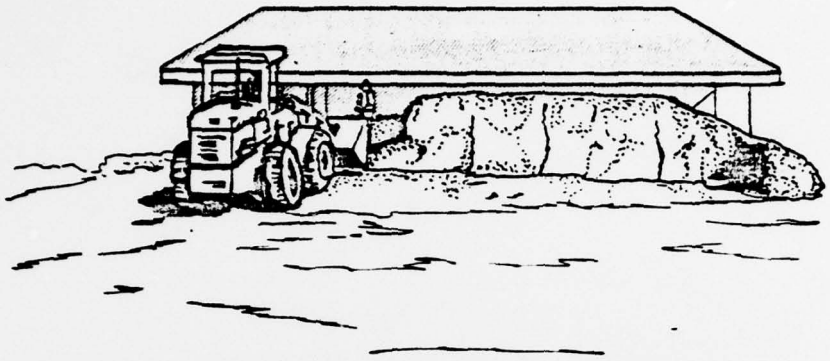


FIGURE A-3a. PLACING BERM AROUND EXTERIOR WALLS.

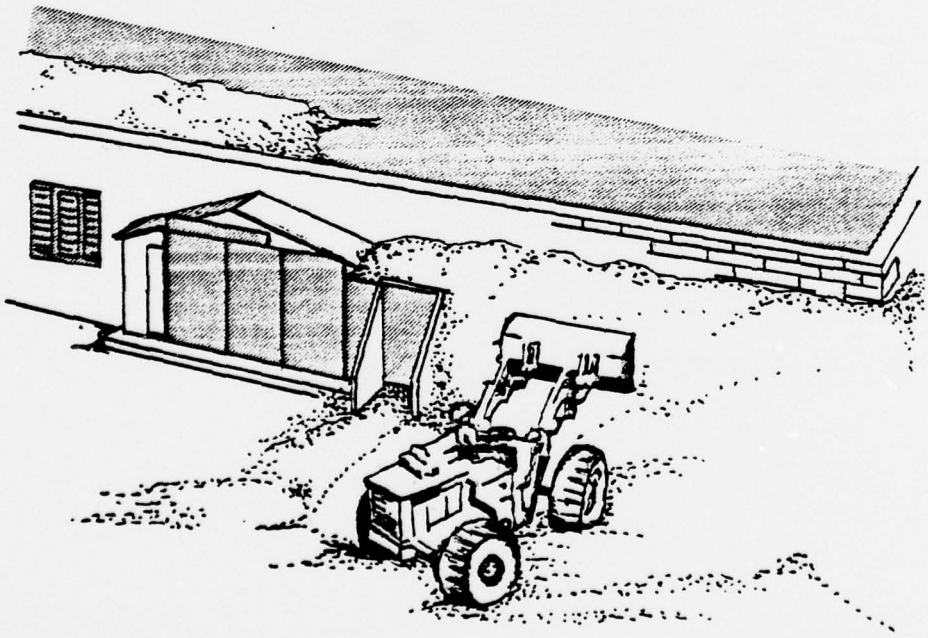


FIGURE A-3b. PLACING BERM AROUND EXTERIOR WALLS.

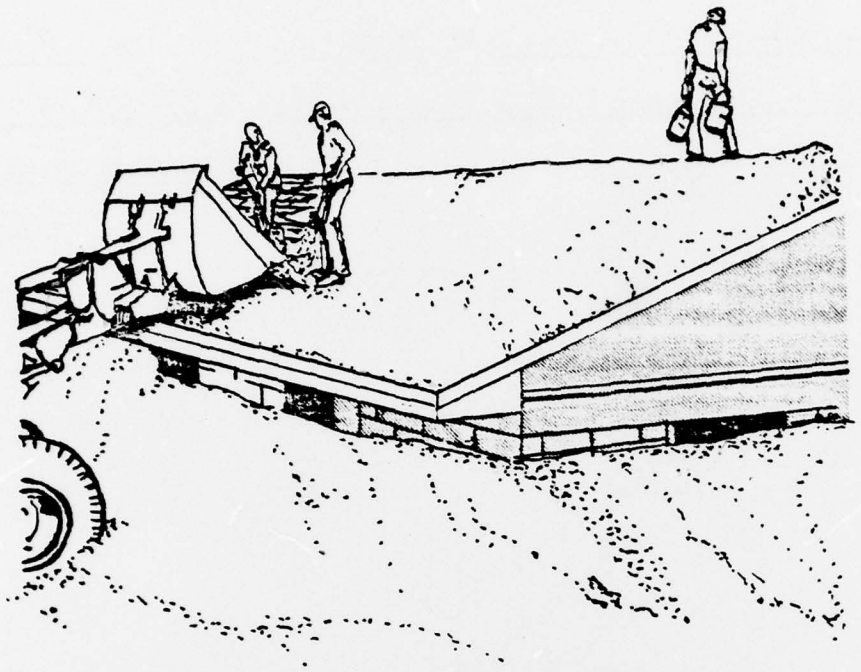


FIGURE A-4a. PLACING SOIL ON SLOPED ROOF.

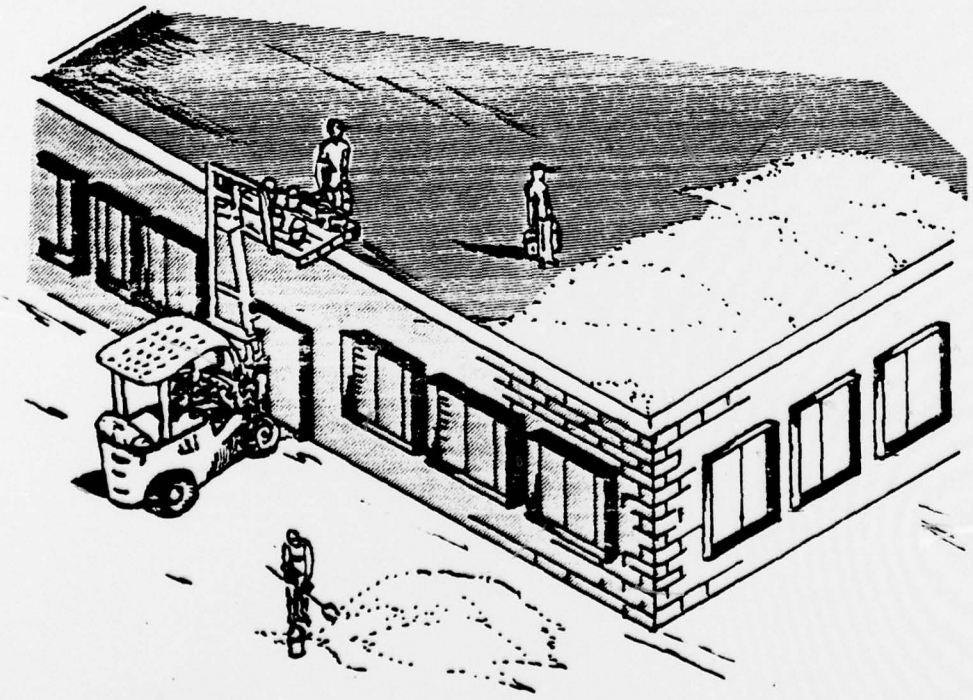
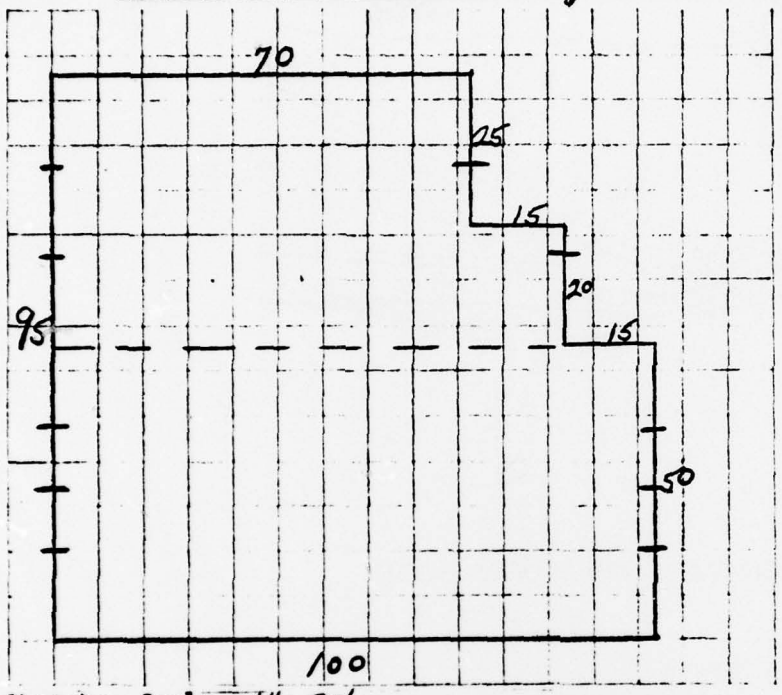


FIGURE A-4b. PLACING SOIL ON FLAT ROOF.

SHELTER UPGRADING DATA FORM

Building Name Camden Collision Service SL 1672/217C Fac. No. 80

Address .5m. S. of the Camden Village Line on W. side of CT 13



Sketch: Scale 1"=30'

Upgrading Actions

1

2

3

4 (24")

See attached pages for definition of upgrading codes.

Shelter Story 1

Spaces: Existing 0

Upgradable 330

Ventilation Requirement 3,300 cfm

Soil Requirement:

Exterior Walls	1,141	yd^3
Overhead		
(Flr.Abv.)	—	yd^3
(roof)	720	yd^3
Total	1,861	yd^3

Tools:

Saws	5
Picks	—
Axes	—
Hammers	5
Shovels	103

Materials:

2" lumber	2,275	lf
4" lumber	—	lf
Plywood	750	ft^2
Nails	4.6	lbs

Labor:

Carpentry	36	man-hours
Excavation	823	man-hours
Machine opr.		man-hours

Equipment _____ yd^3 hrs

UPGRADING ACTIONS

Code	Action
1	Install intermediate supports (as illustrated in Figure A-1) at the positions indicated on the shelter sketch.
2	Board up all exterior openings not used for access or ventilation (as illustrated in Figures A-2a, A-2b, and A-2c).
3	Place soil around all exterior walls to the full height of the floor or roof above the shelter (as illustrated in Figures A-3a and A-3b).
4	Place soil on the floor or roof above the shelter to the depth indicated (as illustrated in Figures A-4a and A-4b).

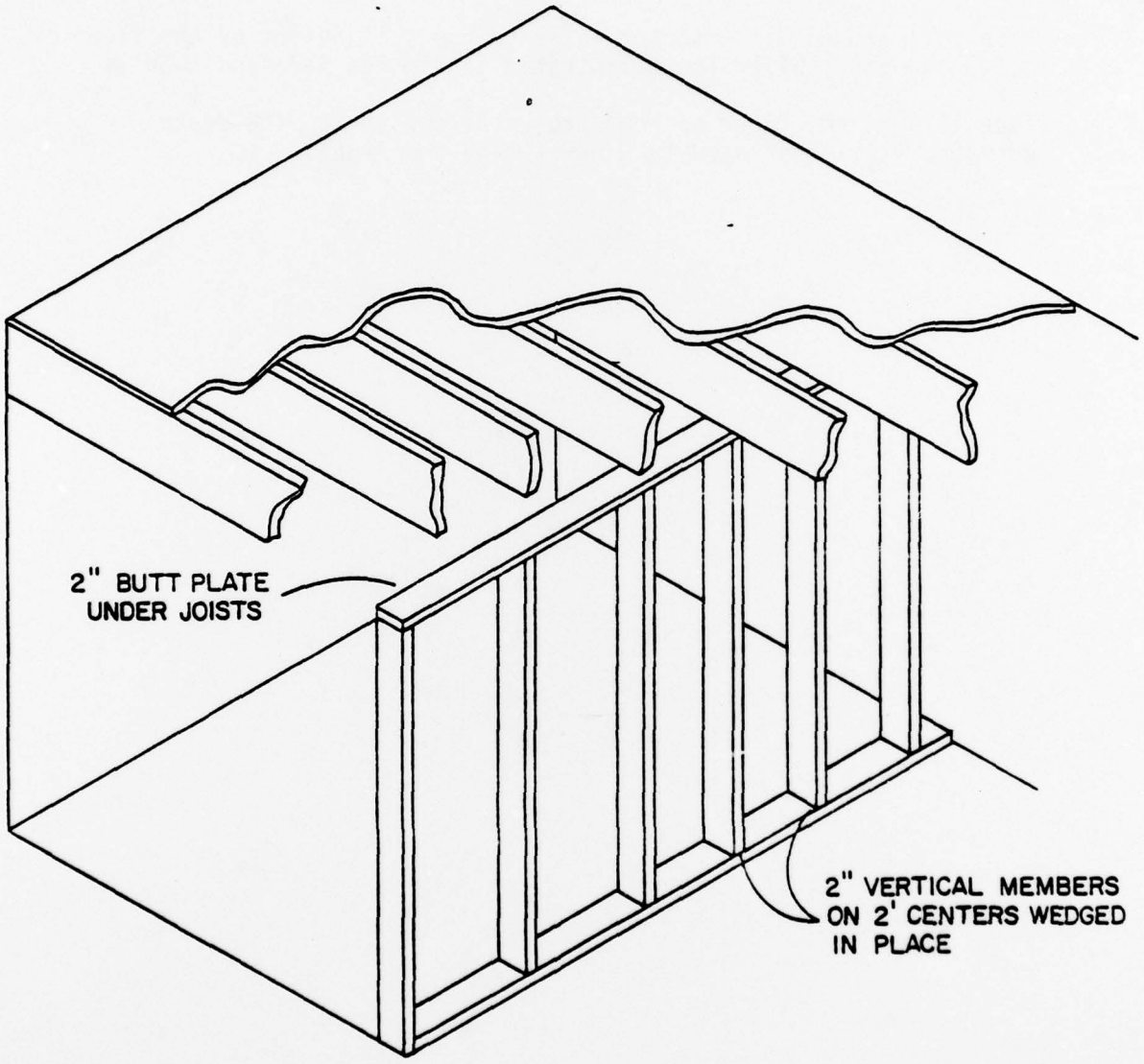


FIGURE A-1 ILLUSTRATION OF INTERMEDIATE SUPPORTS

FIGURE A-2a. PLACING BOARDS OVER EXTERIOR WALL APERTURES.

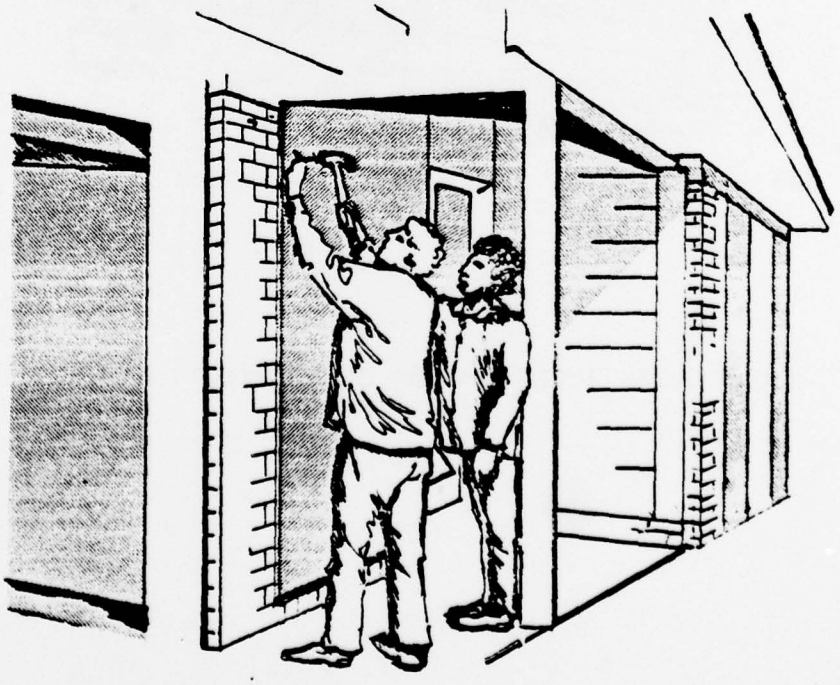


FIGURE A-2b. NAILING BOARDS IN PLACE.

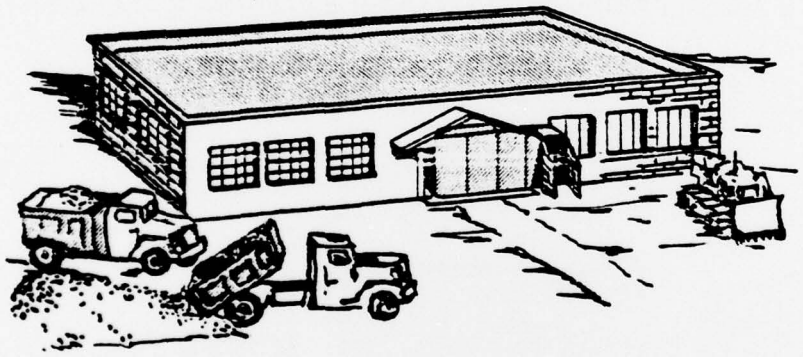


FIGURE A-2c. ILLUSTRATION OF BOARDED OPENINGS.

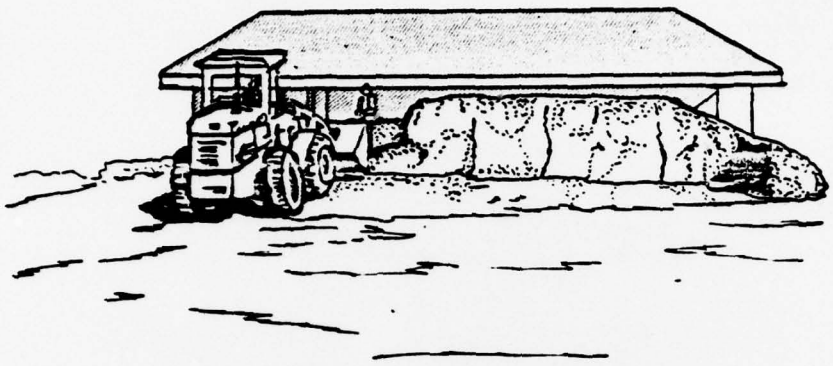


FIGURE A-3a. PLACING BERM AROUND EXTERIOR WALLS.

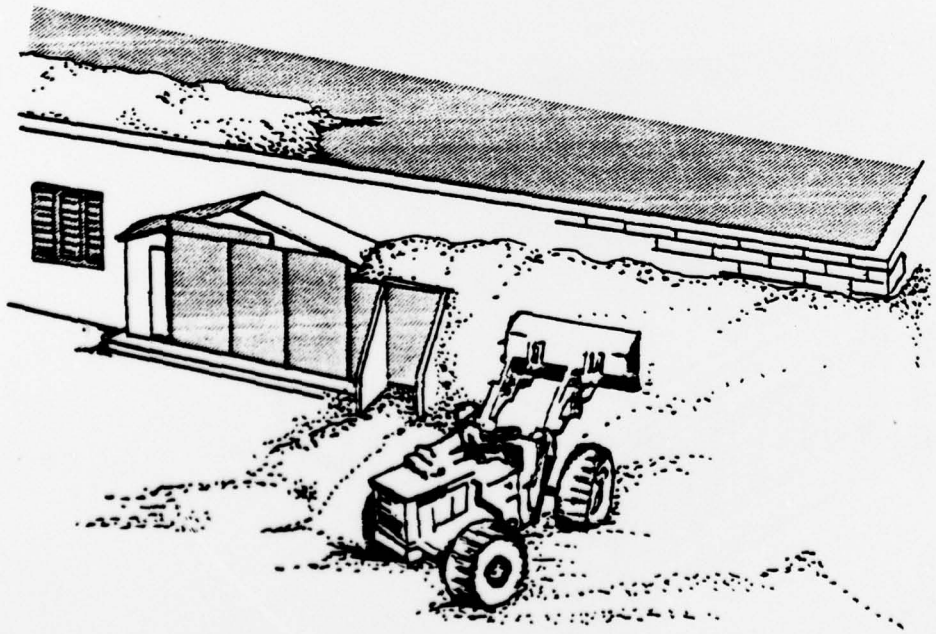


FIGURE A-3b. PLACING BERM AROUND EXTERIOR WALLS.

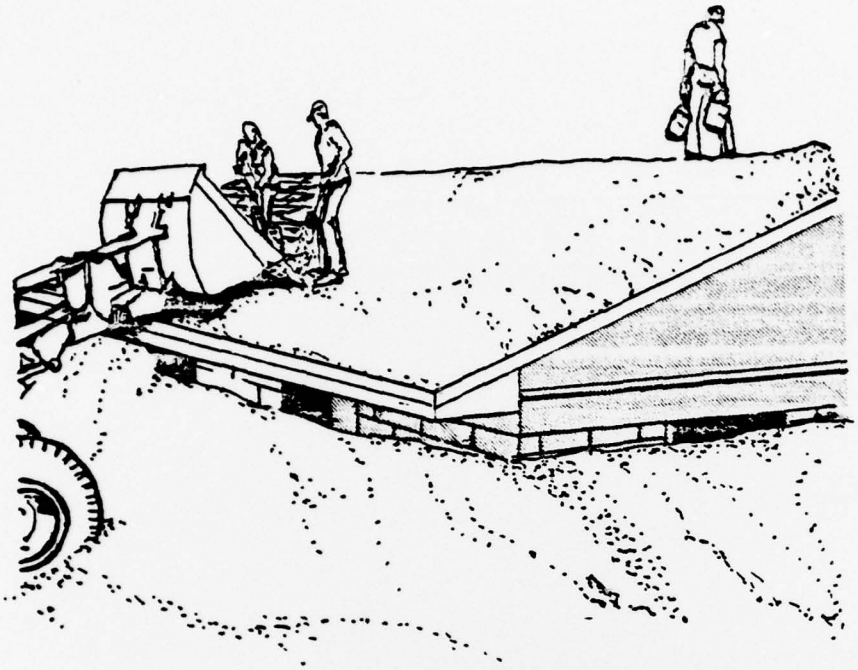


FIGURE A-4a. PLACING SOIL ON SLOPED ROOF.

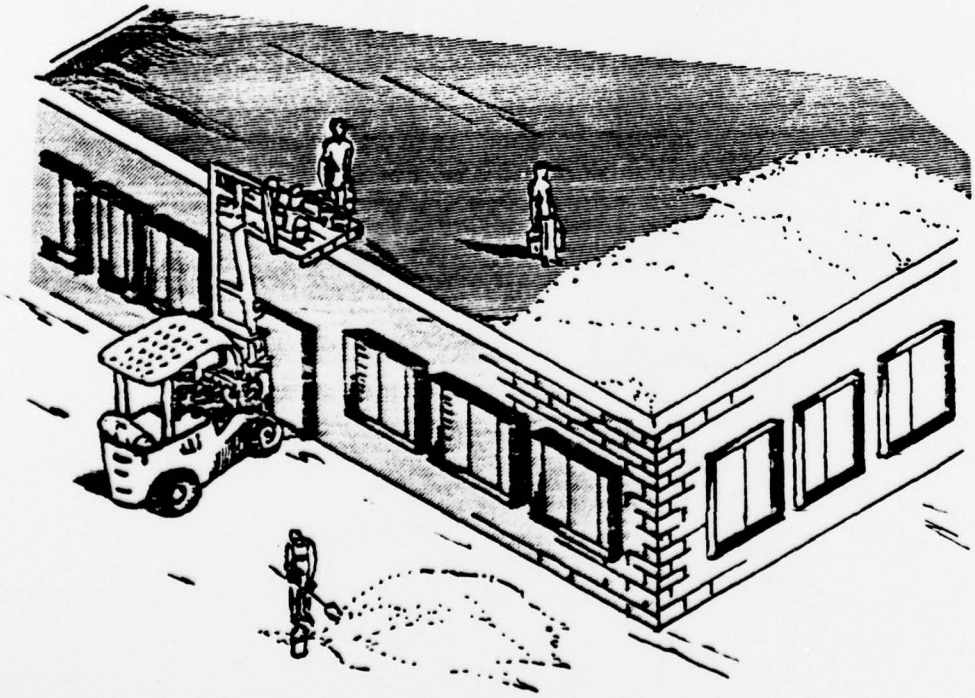


FIGURE A-4b. PLACING SOIL ON FLAT ROOF.

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Development of Shelter Use Plans
Wright, M. D. and Stephen B. York, III
February 1979 (UNCLASSIFIED) 115 pages

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